SERVICE FORESTERS

HANDBOOK

USDA Forest Service

Southeastern Area

in cooperation with
Southeastern Area
State Foresters

USDA Forest Service
Southeastern Area, State & Private Forestry
1720 Peachtree Road, NW
Atlanta, Georgia 30367

Miscellaneous Report SE-MR-10

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CONVERSION FACTORS

Length

Inches	Feet	Yards	Meters	Links	Chains	Rods	Miles
1	0.083	0.0278	0.0254	0.126	--	0.0051	--
7.92	0.66	0.22	0.201	1	0.01	0.04	--
12	1	0.333	0.3048	1.515	0.0152	0.0606	0.00019
36	3	1	0.9144	4.545	0.0455	0.1818	0.00057
39.37	3.2808	1.0936	1.00	4.971	0.0497	0.199	0.00062
198	16.5	5.5	5.03	25.0	.25	1.00	0.00313
792	66	22.0	20.11	100.0	1.00	4.00	0.0125
--	5280	1760.0	1609.3	8000	80.0	32.0	1.00

Area

Square Inches	Square Feet	Square Yards	Square Meters	Square Links	Square Chains	Acres	Ha.
1	.00694	--	--	.0159	--	--	--
62.7264	.4356	--	--	1.0	0.0001	.00001	--
144	1.0	.1111	.0929	2.2957	0.00023	--	--
1296	9.0	1.0	.8361	20.6613	.0021	--	--
15,500	107.64	11.96	10.0	247.106	.025	--	--
--	43560	4840	4046.7	100,000	10.0	1	.4047
--	--	11,960	10,000	--	24.71	2.471	1

PULPWOOD UNIT VOLUME

Units Feet	Gross Volume (Stacked Roundwood) Cubic Feet	Gross Volume (Stacked Roundwood) Cubic Meters	Net Volume* Cubic Feet	Net Volume* Cubic Meter
4 x 4 x 8	128	3.62	90	2.55
4 x 4 1/2 x 8	144	4.08	101	2.86
4 x 5 x 8	160	4.53	113	3.20
4 x 5 1/4 x 8	168	4.76	118	3.34
4 x 6 x 8	192	5.44	135	3.82
4 x 8 x 8	256	7.25	180	5.10

1 ft^3 = .028317 M^3
1 M^3 = 35.313378 ft^3

* Approximate volume.

AREA OF CIRCLES AND SQUARE FEET EQUIVALENTS

Area in Acres	Square Dimension		Radius of Circle		
	Feet	Meters	Feet	Meters	Chains
$\frac{1}{1,000}$	6'7.2"	2.1	3'8.7"	1.14	0.056
$\frac{1}{100}$	20'10.5"	6.36	11'9.3"	3.59	0.18
$\frac{1}{20}$	46'8.0"	14.2	26'4.0"	8.03	0.40
$\frac{1}{10}$	66'0"	20.1	37'2.8"	11.35	0.56
$\frac{1}{5}$	93'4.1"	28.5	52'7.9"	16.05	0.80
$\frac{1}{4}$	104'4.3"	31.8	58'10.5"	17.95	0.89
1	208'8.5"	63.6	117'9.0"	35.89	1.78

SURVEYING CORRECTIONS

DIFFERENCE IN BEARING OR ELEVATION FOR A DISTANCE OF ONE MILE

Angle	Difference (Feet)	Angle	Difference (Feet)
1°	92.16	8°	742.06
2°	184.38	9°	836.27
3°	276.71	10°	931.01
4°	369.21	11°	1026.33
5°	461.94	12°	1122.30
6°	554.95	13°	1218.98
7°	648.30	14°	1316.45

NOTE: One minute of angle makes a difference of 1.536 feet per mile.

METRIC EQUIVALENTS[1]

Length

cm =	0.3937 inches	inch =	2.5400 cm
meter =	3.2808 feet	foot =	0.3048 m
meter =	1.0936 yards	yard =	0.9144 m
km =	0.6214 miles	mile =	1.6093 km

Area

cm^2 =	0.1550 sq. inches	sq. inch =	6.4516 cm^2
m^2 =	10.7639 sq. feet	sq. foot =	0.0929 m^2
m^2 =	1.1960 sq. yards	sq. yard =	0.8361 m^2
ha =	2.4710 acres	acre =	0.4047 ha
km^2 =	0.3861 sq.miles	sq. mile =	2.5900 km^2
m^2/ha =	4.356 sq. ft./ac.	sq. ft./ac. =	0.2296 m^2/ha

Volume

cm^3 =	0.0610 cu. in.	$in.^3$ =	16.3872 cm^3
m^3 =	35.3145 cu. ft.	$ft.^3$ =	0.0283 m^3
m^3 =	1.3079 cu. yd.	$yard^3$ =	0.7646 m^3
m^3/ha =	14.291 cu. ft./acre	cu. ft./ac. =	.06997 m^3ha

Capacity

liter =	61.0250 cu. in.	cu. in. =	0.0164 liter
liter =	0.0353 cu. ft.	cu. ft. =	28.3162 liters
liter =	0.0284 bu. (U.S.)	bu. =	35.2383 liters
liter =	0.2642 gal.(U.S.)	gal.(U.S.) =	3.7853 liters

liter = [1000.027 cm
[1.0567 qt.(liquid) or 0.9081 qt. (dry)
[2.2046 lb. of pure water at 4 c = 1 kg.

Weight

gram	= 15.4324 grains	grain =	0.06f48 g
gram	= 0.0353 oz.	oz. =	28.3495 g
kg	= 2.2046 lb.	pounds =	0.4536 kg
kg	= 0.0011 ton (sht)	Ton(sht) =	907.1848 kg
Ton(met.)	= 1.1023 ton (sht)	Ton(sht) =	0.9072 ton(met.)
Ton(met.)	= 0.9842 ton (lg)	Ton(lg) =	1.0160 ton(met.)
metric ton	= 2204.6 lbs.	cwt. 1 =	45.36 kg

Temperature[2]

Celsius	Fahrenheit	Celsius	Fahrenheit
-17.8	0	10	50
-12.2	10	15.6	60
- 6.7	20	21.1	70
- 1.1	30	26.7	80
0	32	32.2	90
4.4	40	37.8	100

1 Avoid converting measurements previously converted and rounded off.

2 °C x 9/5 + 32 = °F

Seed Tree Spacing

Seed Trees		Spacing Between Trees		
Acre	Hectare	Chains	Feet	Meters
4	10	1.58	104	31
5	12	1.41	93	28
6	15	1.29	85	26
7	17	1.20	79	24
8	20	1.12	74	23
9	22	1.05	69	21
10	25	1.00	66	20
11	27	0.95	63	19
12	30	0.91	60	18
15	37	0.82	54	16
20	49	0.71	47	14
25	62	0.64	42	13

MINIMUM RECOMMENDED NUMBER[1] OF SEED TREES

DBH	Shortleaf	Loblolly	Slash	Longleaf[2]	Virgin
9					6
10	20	12	12	55	5
12	14	9	9	38	4
14	12	6	6	28	4
16+	12	4	4	21	4

1 Needed for satisfactory regeneration
2 Shelterwood - 30 square feet basal area

Specific Gravity by Species

Pine species	Mean age	Mean d.b.h.	Specific gravity Range	Mean
	Years	Inches		
Loblolly	47	14.8	.38 to .68	.51
Longleaf	50	11.7	.40 to .75	.57
Shortleaf	58	12.2	.37 to .72	.52
Slash	30	11.0	.41 to .70	.53
Sand	48	9.1	.41 to .65	.48
Virginia	44	9.8	.40 to .60	.50
White	48	15.6	.25 to .54	.35

SEFES Paper #45

TREES PER ACRE BY DIAMETER AT BREAST HEIGHT AND BASAL AREA

	Basal Area (Square Feet)									
	20	30	40	50	60	70	80	90	100	110
DBH (Inches)	Trees Per Acre									
5	146	220	293	367	440	513	587	660	733	806
6	102	153	204	255	306	357	408	458	509	560
7	75	112	150	187	224	262	299	337	374	412
8	57	86	115	143	172	201	229	258	286	315
9	45	68	91	113	136	158	181	204	226	250
10	37	55	73	92	110	128	147	165	183	202
11	30	45	61	76	91	106	121	136	152	167
12	25	38	51	64	76	89	102	115	127	140
13	22	33	43	54	65	76	97	98	108	119
14	19	28	37	47	56	65	75	84	94	103
15	16	24	33	41	49	57	65	73	81	90
16	14	21	29	36	43	50	57	64	72	79
17	13	19	25	32	38	44	51	57	63	70
18	11	17	23	28	34	40	45	51	57	62
19	10	15	20	25	30	36	41	46	51	56
20	9	14	18	23	28	32	37	41	46	50

Tree diameter outside bark at 4.5 feet above ground in relation to stump diameter at various heights

Stump diameter (inches)	Yellow pine species				Hardwood species			
	Stump height (inches)				Stump height (inches)			
	6	12	18	30	6	12	18	30
	D.b.h.	D.b.h.	D.b.h.	D.b.h.	D.b.h.	D.b.h.	D.b.h.	D.b.h.
6	4	5	5	6	4	5	5	5
7	5	6	6	6	5	5	6	6
8	6	7	7	7	5	6	7	7
9	7	7	8	8	6	7	7	8
10	8	8	9	9	7	8	8	9
11	8	9	10	10	7	8	9	10
12	9	10	10	11	8	9	10	11
13	10	11	11	12	9	10	11	12
14	10	11	12	13	9	11	11	13
15	11	12	13	14	10	11	12	14
16	12	13	14	15	11	12	13	14
17	13	14	15	16	11	13	14	15
18	14	15	16	17	12	14	15	16
19	14	16	16	18	13	14	15	17
20	15	16	17	19	13	15	16	18
21	16	17	18	19	14	16	17	19
22	16	18	19	20	15	17	18	20
23	17	19	20	21	15	17	19	21
24	18	20	21	22	16	18	20	22
25	19	20	22	23	17	19	20	23
26	20	21	22	24	17	20	21	23
27	20	22	23	25	18	20	22	24
28	21	23	24	26	19	21	23	25
29	22	24	25	27	19	22	24	26
30	22	25	26	28	20	23	24	27
Basis: number of trees	1296	1320	380	943	557	620	259	421

USDA FOREST SERVICE
ASHEVILLE, N.C.

SCRIBNER LOG RULE, FORM CLASS 78

GROSS TREE VOLUME

VOLUME (BOARD FEET) BY NUMBER OF USABLE 16-FOOT LOGS

DBH (inches)	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10----	28	36	44	48	52	--	--	--	--
11----	38	49	60	67	74	--	--	--	--
12----	47	61	75	85	95	100	106	--	--
13----	58	76	94	107	120	128	136	--	--
14----	69	92	114	130	146	156	166	--	--
15----	82	109	136	157	178	192	206	--	--
16----	95	127	159	185	211	229	247	--	--
17----	109	146	184	215	246	268	289	--	--
18----	123	166	209	244	280	306	331	--	--
19----	140	190	240	281	322	352	382	--	--
20----	157	214	270	317	364	398	432	459	486
21----	176	240	304	358	411	450	490	523	556
22----	194	266	338	398	458	504	549	588	626
23----	214	294	374	441	508	558	607	652	698
24----	234	322	409	484	558	611	665	718	770
25----	258	355	452	534	617	678	740	799	858
26----	281	388	494	585	676	745	814	880	945
27----	304	420	536	636	736	811	886	959	1,032
28----	327	452	578	686	795	877	939	1,040	1,120
29----	354	491	628	746	864	953	1,042	1,132	1,222
30----	382	530	678	806	933	1,028	1,124	1,224	1,325
31----	411	571	731	871	1,011	1,117	1,223	1,328	1,434
32----	440	612	784	938	1,089	1,206	1,322	1,432	1,543
33----	469	654	838	1,001	1,164	1,289	1,414	1,534	1,654
34----	498	695	892	1,066	1,239	1,373	1,507	1,636	1,766
35----	530	742	954	1,141	1,328	1,473	1,618	1,757	1,896
36----	563	789	1,015	1,216	1,416	1,572	1,728	1,877	2,026
37----	598	836	1,075	1,290	1,506	1,670	1,835	1,998	2,160
38----	629	882	1,135	1,366	1,596	1,769	1,942	2,118	2,295
39----	666	935	1,204	1,449	1,694	1,881	2,088	2,251	2,434
40----	703	988	1,274	1,532	1,791	1,993	2,195	2,384	2,574

NOTE: For each form class above or below 78 determine approximate volume by adding or deducting 3% of total volume.

INTERNATIONAL LOG RULE - 1/4 INCH, FORM CLASS 78

GROSS TREE VOLUME

VOLUME (BOARD FEET) BY NUMBER
USABLE 16-FOOT LOGS

DBH (inches)	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10-----	36	48	59	66	73	--	-	--	-
11-----	46	61	76	86	96	--	-	--	-
12-----	56	74	92	106	120	128	137	--	-
13-----	67	90	112	130	147	158	168	--	-
14-----	78	105	132	153	174	187	200	--	-
15-----	92	124	156	182	208	225	242	--	-
16-----	106	143	180	210	241	263	285	--	-
17-----	121	164	206	242	278	204	330	--	-
18-----	136	184	233	274	314	344	374	--	-
19-----	154	209	264	311	358	392	427	--	-
20-----	171	234	296	348	401	440	480	511	542
21-----	191	262	332	391	450	496	542	579	616
22-----	211	290	368	434	500	552	603	647	691
23-----	231	318	404	478	552	608	663	714	766
24-----	251	346	441	523	605	664	723	782	840
25-----	275	380	484	574	665	732	800	865	930
26-----	299	414	528	626	725	801	877	949	1,021
27-----	323	448	572	680	788	870	952	1,032	1,111
28-----	347	482	616	733	850	938	1,027	1,114	1,201
29-----	375	521	667	794	920	1,016	1,112	1,210	1,308
30-----	403	560	718	854	991	1,094	1,198	1,306	1,415
31-----	432	602	772	921	1,070	1,184	1,299	1,412	1,526
32-----	462	644	826	988	1,149	1,274	1,400	1,518	1,637
33-----	492	686	880	1,053	1,226	1,360	1,495	1,622	1,750
34-----	521	728	934	1,119	1,304	1,447	1,590	1,727	1,864
35-----	555	776	998	1,196	1,394	1,548	1,702	1,851	2,000
36-----	589	826	1,063	1,274	1,485	1,650	1,814	1,974	2,135
37-----	622	873	1,124	1,351	1,578	1,752	1,926	2,099	2,272
38-----	656	921	1,186	1,428	1,670	1,854	2,038	2,224	2,410
39-----	694	976	1,258	1,514	1,769	1,968	2,166	2,359	2,552
40-----	731	1,030	1,329	1,598	1,868	2,081	2,294	2,494	2,693

NOTE: For each form class above or below 78 determine approximate volume by adding or subtracting 3% of total volume.

DOYLE LOG RULE, FORM CLASS 78

GROSS TREE VOLUME

VOLUME (BOARD FEET) BY NUMBER
USABLE 16-FOOT LOGS

Tree Diameter (inches)	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10------	14	17	20	21	22	-----	-----	-----	-----
11------	22	27	32	35	38	-----	-----	-----	-----
12------	29	36	43	48	53	54	56	-----	-----
13------	38	48	59	66	73	76	80	-----	-----
14------	48	62	75	84	93	98	103	-----	-----
15------	60	78	96	108	121	128	136	-----	-----
16------	72	94	116	132	149	160	170	-----	-----
17------	86	113	140	161	182	196	209	-----	-----
18------	100	32	164	190	215	232	248	-----	-----
19------	118	156	194	225	256	276	297	-----	-----
20------	135	180	225	261	297	322	346	364	383
21------	154	207	260	302	344	374	404	428	452
22------	174	234	295	344	392	427	462	492	521
23------	195	264	332	388	444	483	522	558	594
24------	216	293	370	433	496	539	582	625	668
25------	241	328	414	486	558	609	660	709	758
26------	266	362	459	539	619	678	737	793	849
27------	292	398	505	594	684	749	814	877	940
28------	317	434	551	650	750	820	890	961	1,032
29------	346	475	604	714	824	902	980	1,061	1,142
30------	376	517	658	778	898	984	1,069	1,160	1,251
31------	408	562	717	850	983	1,080	1,176	1,273	1,370
32------	441	608	776	922	1,068	1,176	1,283	1,386	1,488
33------	474	654	835	994	1,152	1,268	1,385	1,497	1,609
34------	506	700	894	1,064	1,235	1,361	1,487	1,608	1,730
35------	544	754	964	1,149	1,334	1,472	1,610	1,743	1,876
36------	581	308	1,035	1,234	1,434	1,583	1,732	1,878	2,023
37------	618	860	1,102	1,318	1,534	1,694	1,854	2,013	2,172
38------	655	912	1,170	1,402	1,635	1,805	1,975	2,148	2,322
39------	698	974	1,250	1,498	1,746	1,932	2,118	2,298	2,479
40------	740	1,035	1,330	1,594	1,858	2,059	2,260	2,448	2,636

Note: For each form class point above or below one shown, determine approximate volume by adding or deducting 3% of volume.

SCALE OF 16-FOOT LOGS TO NEAREST BOARD FOOT
SCRIBNER RULE 1/

(Diameter inside bark)
(Tenths of Inches)

D.i.b. in-ches)	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
6----	12	13	14	15	16	16	17	18	19	20
7----	21	22	23	24	24	25	26	27	28	29
8----	30	31	32	33	34	36	37	38	39	41
9----	42	43	45	46	47	48	50	51	52	54
0----	55	56	58	60	61	63	64	66	67	69
1----	70	72	74	75	77	78	80	81	83	84
2----	86	88	90	91	93	95	97	99	101	102
3----	104	106	108	110	111	113	115	117	119	121
4----	123	125	127	129	131	133	135	137	140	142
5----	144	146	148	150	153	155	157	159	161	164
6----	166	168	171	173	175	177	180	182	185	187
7----	189	191	194	196	199	202	204	207	210	213
8----	216	218	221	224	227	229	231	234	237	240
9----	243	245	248	251	254	257	260	263	266	269
0----	272	275	278	281	284	287	290	293	296	299
1----	302	305	308	311	314	317	320	323	327	330
2----	334	337	310	344	348	351	354	358	361	365
3----	368	372	375	379	382	386	390	394	397	400
4----	403	406	410	414	418	422	426	429	432	436
5----	440	444	448	452	456	460	464	468	472	475
6----	478	482	486	490	494	498	502	506	510	514
7----	518	522	526	530	534	538	542	546	550	564
8----	559	563	567	571	575	579	583	587	592	597
9----	602	606	611	615	620	624	629	633	638	642
0----	647	651	656	660	665	669	674	678	683	688
1----	693	698	703	708	712	717	722	726	731	736
2----	741	746	751	756	761	766	770	775	780	785
3----	790	795	800	805	810	815	820	825	830	835
4----	841	846	851	856	862	867	872	877	883	888
5----	894	900	905	910	915	921	926	931	937	942
6----	948	954	959	965	971	977	982	988	993	998
7----	1,004	1,010	1,016	1,021	1,027	1,032	1,038	1,043	1,049	1,055
8----	1,061	1,067	1,073	1,079	1,085	1,091	1,097	1,103	1,109	1,115
9----	1,120	1,126	1,132	1,138	1,144	1,150	1,156	1,162	1,168	1,174
0----	1,180	1,186	1,192	1,198	1,204	1,210	1,216	1,222	1,228	1,235
1----	1,242	1,249	1,255	1,261	1,268	1,274	1,280	1,286	1,293	1,300
2----	1,306	1,312	1,318	1,325	1,331	1,338	1,344	1,351	1,358	1,364

1/ Formula used: $V = .79D^2 - 2D-4$

Mesavage-Girard

SCALE OF 16-FOOT LOGS TO NEAREST BOARD FOOT
INTERNATIONAL RULE 1/4 INCH 1/
(Diameter inside bark)
(Tenths of inches)

D.i.b inches)	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
6---	19	20	21	22	23	23	24	25	26	27
7---	28	29	30	31	32	33	34	35	36	38
8---	39	40	41	42	43	45	46	47	48	50
9---	51	52	54	55	56	58	59	60	62	63
10---	65	66	68	69	71	72	74	75	77	78
11---	80	82	83	85	87	88	90	92	93	95
12---	97	99	100	102	104	106	108	110	112	114
13---	115	117	119	121	123	125	127	129	131	133
14---	136	138	140	142	144	146	148	151	153	155
15---	157	160	162	164	166	169	171	173	176	178
16---	181	183	185	188	190	193	195	198	200	203
17---	205	208	211	213	216	219	221	224	227	229
18---	232	235	237	240	243	246	249	251	254	257
19---	260	263	266	269	272	275	278	281	284	287
20---	290	293	296	209	302	305	308	311	315	318
21---	321	324	327	331	334	337	341	344	347	351
22---	354	357	361	364	367	371	374	378	381	385
23---	388	392	395	399	403	406	410	413	417	421
24---	424	428	432	435	439	443	447	451	454	458
25---	462	466	470	474	478	481	485	489	493	497
26---	501	505	509	513	517	521	526	530	534	538
27---	542	546	550	555	559	563	567	572	576	530
28---	584	589	593	598	602	606	611	615	620	624
29---	628	633	637	642	647	651	656	660	665	669
30---	674	679	683	683	693	697	702	707	712	716
31---	721	726	731	736	741	745	750	755	760	765
32---	770	775	780	785	790	795	800	805	810	815
33---	820	826	831	836	841	846	851	857	862	867
34---	872	878	883	888	894	899	904	910	915	921
35---	826	931	937	942	948	953	959	964	970	976
36---	981	987	902	998	1,004	1,009	1,015	1,021	1,026	1,032
37---	1,038	1,044	1,049	1,055	1,061	1,067	1,073	1,079	1,084	1,090
38---	1,096	1,102	1,108	1,114	1,120	1,126	1,132	1,138	1,144	1,150
39---	1,156	1,162	1,168	1,174	1,181	1,187	1,193	1,199	1,205	1,211
40---	1,218	1,224	1,230	1,236	1,243	1,249	1,255	1,262	1,268	1,274
41---	1,281	1,287	1,294	1,300	1,306	1,313	1,319	1,326	1,332	1,339
42---	1,345	1,352	1,359	1,365	1,372	1,378	1,385	1,392	1,398	1,405
43---	1,412	1,419	1,425	1,432	1,439	1,446	1,452	1,459	1,466	1,473
44---	1,480	1,487	1,493	1,500	1,507	1,514	1,521	1,528	1,535	1,542
45---	1,549	1,556	1,563	1,570	1,577	1,585	1,592	1,599	1,606	1,613
46---	1,620	1,627	1,635	1,642	1,649	1,656	1,664	1,671	1,678	1,686
47---	1,693	1,700	1,708	1,715	1,722	1,730	1,737	1,745	1,752	1,760
48---	1,767	1,775	1,782	1,790	1,797	1,805	1,813	1,820	1,828	1,835

1/ Formula used $V = 0.796\ D^2 - 1.376\ D - 1.230$
Mesavage-Girard

SCALE OF 16-FOOT LOGS TO NEAREST BOARD FOOT FROM DOYLE RULE[1]

(Diameter inside bark)

(Tenths of Inches)

D.i.b. (inches)	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
5----	1	1	1	2	2	2	3	3	3	4
6----	4	4	5	5	6	6	7	7	8	8
7----	9	10	10	11	12	12	13	14	14	15
8----	16	17	18	18	19	20	21	22	23	24
9----	25	26	27	28	29	30	31	32	34	35
10----	36	37	38	40	41	42	44	45	46	48
11----	49	50	52	53	55	56	58	59	61	62
12----	64	66	67	69	71	72	74	76	77	79
13----	81	83	85	86	88	90	92	94	96	98
14----	100	102	104	106	108	110	112	114	117	119
15----	121	123	125	128	130	132	135	137	139	142
16----	144	146	149	151	154	156	159	161	164	166
17----	169	172	174	177	180	182	185	188	190	193
18----	196	199	202	204	207	210	213	216	219	222
19----	225	228	231	234	237	240	243	246	250	253
20----	256	259	262	266	269	272	276	279	282	288
21----	289	292	296	299	303	306	310	313	317	320
22----	324	328	331	335	339	342	346	350	353	357
23----	361	365	369	372	376	380	384	388	392	396
24----	400	404	408	412	416	420	424	428	433	437
25----	441	445	449	454	458	462	467	471	475	480
26----	484	488	493	497	502	505	511	515	520	524
27----	529	534	538	543	548	552	557	562	566	571
28----	576	581	586	590	595	600	606	610	615	620
29----	625	630	635	640	645	650	655	660	665	671
30----	678	681	686	692	697	702	706	713	718	724
31----	729	734	740	748	751	756	762	767	773	778
32----	784	790	796	801	807	812	818	824	829	835
33----	841	847	853	856	864	870	876	882	888	894
34----	900	906	912	918	924	930	936	942	949	956
35----	951	967	973	980	985	992	999	1,005	1,011	1,018
36----	1,024	1,030	1,037	1,043	1,050	1,056	1,063	1,069	1,076	1,082
37----	1,089	1,096	1,102	1,109	1,116	1,122	1,129	1,136	1,142	1,149
38----	1,156	1,163	1,170	1,176	1,183	1,190	1,197	1,204	1,211	1,218
39----	1,225	1,232	1,239	1,246	1,252	1,260	1,267	1,274	1,282	1,290
40----	1,296	1,303	1,310	1,318	1,325	1,332	1,340	1,347	1,354	1,362
41----	1,369	1,376	1,394	1,391	1,399	1,406	1,414	1,421	1,429	1,436
42----	1,444	1,452	1,459	1,467	1,475	1,482	1,490	1,498	1,505	1,513

[1] Computed from formula: $\frac{(D-4)^2 \times L}{16}$

Mesavage - Girard

Merchantable Rough Cord Volume Using Total Tree Height
(Form classes 65-69)
By Charles O. Minor

Diameter breast high (inches)	Total Tree Height (feet)							
	30	40	50	60	70	80	90	100
	Pulpwood Volume (Rough Cords)							
5	0.020	0.025	0.028	0.032				
6	0.029	0.035	0.040	0.045	0.052			
7	0.041	0.049	0.057	0.065	0.072	0.078		
8	0.055	0.063	0.074	0.084	0.094	0.104		
9	0.066	0.078	0.091	0.104	0.116	0.128	0.139	
10		0.097	0.115	0.132	0.148	0.165	0.179	
11		0.117	0.138	0.156	0.175	0.194	0.212	0.229
12		0.136	0.160	0.182	0.207	0.226	0.250	0.272
13		0.162	0.191	0.217	0.243	0.269	0.295	0.324
14			0.221	0.250	0.280	0.309	0.343	0.372
15			0.247	0.280	0.313	0.351	0.389	0.422
16			0.277	0.313	0.350	0.391	0.433	0.469

(Form Classes 70-74)

Diameter breast high (inches)	Total Tree Height (feet)							
	30	40	50	60	70	80	90	100
	Pulpwood Volume (rough Cords)							
5	0.021	0.026	0.030	0.034				
6	0.032	0.039	0.046	0.051	0.059			
7	0.045	0.054	0.063	0.071	0.080	0.088		
8	0.063	0.073	0.086	0.098	0.110	0.121		
9	0.077	0.090	0.106	0.121	0.135	0.148	0.162	
10		0.110	0.132	0.151	0.170	0.188	0.205	
11		0.130	0.154	0.176	0.197	0.219	0.240	0.259
12		0.154	0.183	0.208	0.237	0.259	0.287	0.313
13		0.184	0.218	0.248	0.277	0.307	0.341	0.371
14			0.252	0.286	0.321	0.355	0.394	0.429
15			0.282	0.321	0.360	0.403	0.447	0.485
16			0.317	0.360	0.404	0.452	0.501	0.544

(Form Classes 75-79)

Diameter breast high (inches)	Total Tree Height (feet)							
	30	40	50	60	70	80	90	100
	Pulpwood Volume (Rough Cords)							
5	0.023	0.029	0.034	0.038				
6	0.036	0.045	0.052	0.058	0.068			
7	0.052	0.062	0.073	0.082	0.092	0.101		
8	0.069	0.081	0.096	0.109	0.122	0.136		
9	0.084	0.099	0.117	0.134	0.149	0.164	0.180	
10		0.124	0.148	0.170	0.192	0.213	0.232	
11		0.148	0.176	0.201	0.226	0.251	0.276	0.298
12		0.174	0.207	0.236	0.269	0.295	0.328	0.357
13		0.205	0.243	0.277	0.311	0.345	0.384	0.417
14			0.282	0.321	0.360	0.399	0.443	0.482
15			0.324	0.369	0.414	0.466	0.517	0.562
16			0.357	0.407	0.455	0.511	0.566	0.627

Merchantable Rough Cord Volume Using Merchantable Stem Length
(Form Classes 65-69)
By Charles O. Minor

Diameter breast high inches	Merchantable Length of Stem (feet)													
	20	25	30	35	40	45	50	55	60	65	70	75	80	85
	Pulpwood Volume (Rough Cords)													
5	0.023	0.026	0.029	0.033										
6	0.029	0.033	0.038	0.042	0.046	0.051								
7	0.038	0.043	0.049	0.055	0.060	0.066	0.072	0.077						
8	0.047	0.055	0.062	0.069	0.076	0.083	0.090	0.097	0.104					
9	0.057	0.065	0.073	0.081	0.090	0.098	0.106	0.114	0.123	0.131	0.139			
10	0.070	0.080	0.091	0.101	0.111	0.121	0.132	0.142	0.152	0.162	0.173	0.183		
11	0.084	0.096	0.107	0.119	0.131	0.142	0.154	0.166	0.177	0.189	0.201	0.212	0.224	
12	0.098	0.111	0.125	0.139	0.152	0.166	0.179	0.193	0.207	0.220	0.234	0.247	0.261	0.275
13	0.113	0.130	0.146	0.162	0.178	0.195	0.211	0.227	0.243	0.259	0.276	0.292	0.308	0.324
14	0.132	0.150	0.169	0.187	0.206	0.224	0.243	0.261	0.280	0.298	0.317	0.335	0.354	0.372
15	0.146	0.167	0.188	0.209	0.230	0.251	0.272	0.293	0.313	0.334	0.355	0.376	0.397	0.418
16	0.167	0.189	0.212	0.235	0.258	0.281	0.304	0.327	0.350	0.373	0.396	0.419	0.442	0.465

Merchantable Rough Cord Volume Using Merchantable Stem Length
(Form Classes 70-74)
By Charles O. Minor

Diameter breast high (inches)	Merchantable Length of Stem (feet)													
	20	25	30	35	40	45	50	55	60	65	70	75	80	85
	Pulpwood Volume (Rough Cords)													
5	0.024	0.028	0.032	0.036										
6	0.032	0.037	0.043	0.048	0.053	0.058								
7	0.041	0.048	0.054	0.061	0.067	0.074	0.080	0.087						
8	0.054	0.063	0.071	0.079	0.088	0.096	0.105	0.113	0.121					
9	0.065	0.075	0.085	0.094	0.104	0.114	0.123	0.133	0.142	0.152	0.162			
10	0.080	0.092	0.103	0.115	0.127	0.139	0.151	0.162	0.174	0.186	0.198	0.210		
11	0.093	0.106	0.120	0.133	0.146	0.160	0.173	0.186	0.200	0.213	0.227	0.240	0.253	
12	0.110	0.126	0.142	0.157	0.173	0.189	0.205	0.221	0.237	0.253	0.268	0.284	0.300	0.316
13	0.128	0.147	0.165	0.184	0.203	0.221	0.240	0.259	0.277	0.296	0.315	0.333	0.352	0.371
14	0.148	0.170	0.191	0.213	0.234	0.256	0.278	0.299	0.321	0.342	0.364	0.386	0.407	0.429
15	0.166	0.190	0.215	0.239	0.263	0.287	0.311	0.335	0.360	0.384	0.408	0.432	0.456	0.481
16	0.188	0.215	0.242	0.269	0.296	0.323	0.350	0.377	0.404	0.431	0.458	0.484	0.511	0.538

Merchantable Rough Cord Volume Using Merchantable Stem Length
(Form Classes 75-79)
By Charles O. Minor

Diameter breast high (inches)	Merchantable Length of Stem (Feet)													
	20	25	30	35	40	45	50	55	60	65	70	75	80	85
	Pulpwood Volume (Rough Cords)*													
5	0.026	0.031	0.035	0.040										
6	0.036	0.042	0.048	0.054	0.060	0.067								
7	0.047	0.055	0.062	0.070	0.077	0.085	0.092	0.100						
8	0.060	0.069	0.079	0.088	0.098	0.107	0.117	0.126	0.136					
9	0.071	0.082	0.093	0.104	0.115	0.125	0.136	0.147	0.158	0.169	0.180			
10	0.089	0.102	0.116	0.129	0.143	0.156	0.170	0.184	0.197	0.211	0.224	0.238		
11	0.105	0.120	0.136	0.151	0.167	0.183	0.198	0.214	0.229	0.245	0.261	0.276	0.292	
12	0.122	0.141	0.159	0.177	0.196	0.214	0.232	0.251	0.269	0.287	0.306	0.324	0.342	0.361
13	0.142	0.163	0.184	0.205	0.226	0.248	0.269	0.290	0.311	0.333	0.354	0.375	0.396	0.417
14	0.165	0.189	0.214	0.238	0.262	0.287	0.311	0.336	0.360	0.384	0.409	0.433	0.458	0.482
15	0.188	0.216	0.244	0.273	0.301	0.329	0.358	0.386	0.414	0.443	0.471	0.500	0.528	0.556
16	0.210	0.241	0.271	0.302	0.333	0.363	0.394	0.425	0.455	0.486	0.517	0.547	0.578	0.609

*Cord = Stack of 4' X 4' X 8' roundwood

Trees per Rough Cord using Merchantable Stem Length
(Form Classes 70 - 74)
F.C. 72

Diameter breast high (inches)	Merchantable Length of Stem (feet)													
	20	25	30	35	40	45	50	55	60	65	70	75	80	85
	Number of Trees per Rough Cord of Pulpwood													
5	42	36	31	28										
6	31	27	23	21	19	17								
7	24	21	19	16	15	14	12	11						
8	19	16	14	13	11	10	10	9	8					
9	15	13	12	11	10	9	8	8	7	7	6			
10	12	11	10	9	8	7	7	6	6	5	5	5		
11	11	9	8	8	7	6	6	5	5	5	4	4	4	
12	9	8	7	6	6	5	5	5	4	4	4	4	3	3
13	8	7	6	5	5	5	4	4	4	3	3	3	3	3
14	7	6	5	5	4	4	4	3	3	3	3	3	2	2
15	6	5	5	4	4	3	3	3	3	3	2	2	2	2
16	5	5	4	4	3	3	3	3	2	2	2	2	2	2

Trees per Rough Cord using Merchantable Stem Length
(Form Classes 75 - 79)
F.C. 77

Diameter breast high (inches)	Merchantable Length of Stem (feet)													
	20	25	30	35	40	45	50	55	60	65	70	75	80	85
	Number of Trees per Rough Cord of Pulpwood													
5	38	32	29	25										
6	28	24	21	19	17	15								
7	21	18	16	14	13	12	11	10						
8	17	14	13	11	10	9	9	8	7					
9	14	12	11	10	9	8	7	7	6	6	6			
10	11	10	9	8	7	6	6	5	5	5	4	4		
11	10	8	7	7	6	5	5	5	4	4	4	4	3	
12	8	7	6	6	5	5	4	4	4	3	3	3	3	3
13	7	6	5	5	4	4	4	3	3	3	3	3	3	2
14	6	5	5	4	4	3	3	3	3	3	2	2	2	2
15	5	5	4	4	3	3	3	3	2	2	2	2	2	2
16	5	4	4	3	3	3	3	2	2	2	2	2	2	2

Cubic foot volume, including bark, for stands of southern pine that are above average form[1]

Form point	Dbh	Merchantable length of stem in feet: 12	16	20	24	28	32	36	40	44	48	52	56	60	64	Mid Diameter
Pct.	In.	Cubic Feet														
85	6	1.7	2.3	2.8	3.4	4.0	4.3	5.1								5.1
83	8		3.8	4.8	3.8	6.7	7.7	8.7	9.6	10.6	11.6					6.7
81	10			7.2	8.6	10.0	11.4	12.9	14.3	15.7	17.2	18.6	20.0	21.5		8.1
79	12				11.8	13.7	13.7	17.6	17.6	21.6	23.3	25.5	27.4	29.4	31.4	9.3
77	14					17.7	20.3	22.8	25.3	27.9	30.4	32.9	35.5	36.0	40.3	10.8
75	16						25.1	28.3	31.4	34.3	37.7	40.8	43.9	47.1	30.2	12.0

Cubic foot volume, including bark, for stands of southern pine that are of average form[1]

Form point	Dbh	Merchantable length of stem in feet: 12	16	20	24	28	32	36	40	44	48	52	56	60	64	Mid Diameter
Pct.	In.	Cubic Feet														
85	6	1.6	2.2	2.7	3.2	3.8	4.3	4.8								4.95
83	8		3.6	4.6	5.3	6.4	7.3	8.3	9.1	10.1	11.0					6.50
81	10			6.8	8.2	9.3	10.8	12.3	13.6	14.9	16.3	17.7	19.0	20.4		7.92
79	12				11.2	13.0	14.9	16.7	18.6	20.5	22.3	24.2	26.0	27.9	29.8	9.23
77	14					16.8	19.3	21.7	24.0	26.5	28.9	31.3	33.7	36.1	38.3	10.31
75	16						23.8	26.9	29.8	32.8	33.8	38.8	41.7	44.7	47.7	11.71

[1]See footnote, page 20.

Cubic foot volume, including bark, for stands, of southern pine that are below average form [1] (Continued)

Form Point	Dbh	Merchantable length of stem in feet														Mid Diameter
		12	16	20	24	26	32	36	40	44	48	52	56	60	64	
Pct.	In.	Cubic Feet														In.
81	6	1.6	2.1	2.6	3.1	3.7	4.2	4.7								4.9
79	8		3.5	4.3	5.2	6.0	6.9	7.8	8.6	9.5	10.4					6.3
77	10			6.3	7.8	9.0	10.3	11.6	12.9	14.2	15.3	16.8	18.1	19.4		7.7
75	12				10.6	12.4	14.1	15.9	17.7	19.4	21.2	23.0	24.8	26.3	28.3	9.0
73	14					15.9	18.1	20.4	22.7	24.9	27.2	29.3	31.8	24.0	36.3	10.2
71	16						22.7	25.3	28.4	31.2	34.0	36.9	39.7	42.5	45.4	11.4

[1] Top utilization, 5 inches outside bark. Tables 45,46, 47 varies from 3.8 to 6 inches. Source for Tables 45, 46, 47: Hawes, E. T. 1940. Volume tables, converting factors and information applicable to commercial timber in the South. 3rd. ed., U.S.D.A. Forest Serv., Div. of State and Private Forestry, Atlanta, Ga.

STANDARD CUBIC FOOT VOLUME TABLE SOUTHERN PINES OUTSIDE BARK

DBH	MERCHANTABLE HEIGHT IN FEET								
in.	10	20	30	40	50	60	70	80	90
	Cubic Feet (OB) to 4-inch Top								
5	.7								
6	1.1	2.1	3.2						
7	1.4	2.9	4.3						
8	1.9	3.7	5.6	7.5					
9	2.4	4.7	7.1	9.5	11.4				
10	2.9	5.8	8.8	11.7	14.6				
11	3.5	7.1	10.6	14.1	17.7	21.2	24.7		
12	4.2	8.4	12.6	16.8	21.0	25.2	29.4		
13	4.9	9.9	14.8	19.7	24.6	29.6	34.5	39.5	
14	5.7	11.5	17.2	22.9	28.6	34.3	40.1	45.8	51.5
15	6.6	13.1	19.7	26.3	32.8	39.4	46.0	52.6	59.1
16	7.5	15.0	22.4	29.9	37.4	44.8	52.3	59.8	67.3
17	8.4	16.9	25.3	33.8	42.2	50.6	59.1	67.5	75.9
18	9.5	18.9	28.4	37.8	47.3	56.8	66.2	75.7	85.1
19	10.5	21.1	31.6	42.2	52.7	63.2	73.8	84.3	94.8
20	11.7	23.4	35.0	46.7	58.4	70.1	81.7	93.4	105.1
21	12.9	23.8	38.6	51.5	64.4	77.2	90.1	103.0	115.9
22	14.1	28.3	42.4	56.5	70.6	84.8	98.9	113.0	127.2
23	15.5	30.9	46.3	61.8	77.2	92.7	108.1	123.5	139.0
24	16.8	33.6	50.4	67.3	84.1	101.0	117.7	134.5	151.3
25	18.3	36.5	54.7	73.0	91.2	109.3	127.7	146.0	164.2
26	19.7	39.5	59.2	78.9	98.7	118.4	138.1	157.9	177.6
27	21.3	42.6	63.8	85.1	106.4	127.7	149.0	170.2	191.5
28	22.9	45.8	68.7	91.5	114.4	137.3	160.2	183.1	206.0
29	24.6	49.1	73.7	98.2	122.7	147.3	171.8	196.4	220.9
30	26.3	52.5	78.8	105.1	131.4	157.6	183.9	210.2	236.4
31	28.1	56.1	84.2	112.2	140.3	168.3	196.3	224.4	252.5
32	29.9	59.8	89.7	119.6	149.7	179.3	209.2	239.1	269.0
33	31.8	63.6	95.4	127.2	158.9	190.7	222.5	254.3	286.1
34	33.7	67.5	101.2	135.0	168.7	202.5	236.2	269.9	303.7

From: James H. Hemping, School of Forestry, University of Georgia, Athens.

Merchantable cubic foot volume, inside bark,

based on total height[1]

Dbh.	Total tree height							
	30	40	50	60	70	80	90	100
In.	Cubic feet							
	Form Classes 65-69, Average 67							
6	2.1	2.5	2.9	3.2	3.7			
8	4.1	4.7	5.6	6.3	7.1	7.8		
10		7.5	8.9	10.2	11.5	12.7	13.8	
12		10.8	12.7	14.5	16.4	17.9	19.9	21.6
14			17.8	20.2	22.6	25.0	27.7	30.1
16			22.7	25.7	28.7	32.1	35.5	38.5
	Form classes 70-74, Average 72							
6	2.3	2.8	3.3	3.7	4.3			
8	4.7	5.5	6.5	7.4	8.2	9.1		
10		8.6	10.2	11.7	13.1	14.6	15.9	
12		12.2	14.5	16.5	18.8	20.6	22.8	24.8
14			20.3	23.1	25.9	28.7	31.8	34.6
16			26.0	29.5	33.1	37.1	41.0	44.6
	Form classes 75-79, Average 77							
6	2.6	3.2	3.8	4.2	4.9			
8	5.2	6.0	7.2	8.2	9.2	10.2		
10		9.6	11.5	13.2	14.8	16.5	18.0	
12		13.8	16.4	18.7	21.4	23.4	26.0	28.4
14			22.8	25.9	29.1	32.2	35.8	38.9
16			29.3	33.3	37.3	41.9	46.4	50.4
	Form classes 80-84, Average 82							
6	2.8	3.5	4.1	4.6	5.3			
8	5.8	6.8	8.1	9.2	10.3	11.4		
10		10.8	12.9	14.8	16.8	18.6	20.3	
12		15.2	18.2	20.7	23.6	25.9	28.8	31.4
14			25.6	29.3	32.9	36.5	40.6	44.2
16			32.7	37.3	41.8	46.9	52.0	56.6
	Form classes 85-89, Average 87							
6	3.2	4.0	4.6	5.2	6.0			
8	6.5	7.6	9.0	10.2	11.5	12.7		
10		11.9	14.3	16.5	18.6	20.7	22.6	
12		17.2	20.5	23.4	26.7	29.3	32.6	35.5
14			28.4	32.4	36.4	40.5	45.0	49.0
16			36.4	41.5	46.6	52.3	58.0	63.1

[1]Compiled from Miner's (1950) form class volume tables.
Source: Burns, Paul Y. 1965. A condensation of Minor's form class volume tables for southern pine pulpwood. La.Agr.Exp.Sta., LSU Forestry Note 61.

Planted Loblolly Volume
Tables per acre

AGE	Site Index						
	65	70	75	80	85	90	95
	YIELD IN STD. CDS.						
15	15	17	19	22	25	29	33
16	16	19	21	24	28	32	37
17	18	21	24	27	31	36	41
18	20	23	26	30	34	39	45
19	21	25	28	32	37	42	48
20	23	26	30	35	40	45	52
21	25	28	32	37	42	48	56
22	26	30	34	39	45	52	59
23	28	32	36	42	48	54	62
24	29	33	38	44	50	57	65
25	31	35	40	46	52	60	69
26	32	36	42	48	55	63	72
27	33	38	43	50	57	65	74
28	34	39	45	52	59	68	77
29	36	41	47	53	61	70	80
30	37	42	48	55	63	72	83

For converted stands use 3/4 of above values

LOBLOLLY PLANTATION AVERAGE ANNUAL GROWTH PER ACRE

Age	Site Index In Feet						
	65	70	75	80	85	90	95
	Average Annual Growth Std. Cds.						
15	0.97	1.11	1.27	1.45	1.66	1.90	2.18
20	1.16	1.32	1.51	1.73	1.98	2.27	2.60
25	1.22	1.40	1.60	1.83	2.09	2.40	2.74
30	1.22	1.40	1.60	1.84	2.10	2.40	2.75

Virginia Division of Forestry, Occ. Report #21

SIZE, CUBIC VOLUME AND BOARD FOOT VOLUME IN PINE POLES

Class and Min. Circum. and Equiv. Diameter (Inches)	Length (Feet)	Vol. (Cu. Feet)	Average Volume, Board Feet, Int'l. Rule 1/4"	Average Volume, Board Ft., Scribner Rule, Form Class 80	Min. Circum. and Diameter Equivalent to 6 feet of First Log Circum.	Diam.
Class 1						
27" Circum.	25	15.3	86	75	33.5	10.66
8.59" Diam.	30	20.4	114	125	36.5	11.62
	35	26.2	153	155	39.0	12.41
	40	32.6	182	205	41.0	13.05
	45	39.3	217	245	43.0	13.69
	50	46.6	271	280	45.0	14.32
	55	54.3	306	335	46.5	14.80
	60	62.6	342	385	48.0	15.28
	65	71.1	397	420	49.5	15.76
	70	80.1	441	495	51.0	16.23
	75	89.5	486	535	52.5	16.71
Class 2	25	13.2	74	60	31.5	10.03
25" Circum.	30	17.8	96	105	34.0	10.82
7.96 Diam.	35	22.8	131	135	36.5	11.62
	40	28.2	158	175	38.5	12.25
	45	34.1	189	210	40.5	12.89
	50	40.4	231	240	42.0	13.37
	55	47.1	261	295	43.5	13.85
	60	54.2	295	325	45.0	14.32
	65	61.6	344	365	46.5	14.80
	70	69.5	381	425	48.0	15.28
	75	77.7	410	500	49.0	15.60
Class 3	25	11.5	63	70	29.5	9.39
23" Circum.	30	15.4	82	85	32.0	10.19
7.32" Diam.	35	19.7	107	115	34.0	10.82
	40	24.5	135	150	36.0	11.46
	45	29.5	157	180	37.5	11.94
	50	35.0	194	205	39.0	12.41
	55	40.8	222	250	40.5	12.89
	60	47.0	249	280	42.0	13.37
	65	53.4	294	310	43.5	13.85
	70	60.2	328	340	45.0	14.32
	75	67.3	352	380	46.0	14.64
Class 4	25	10.0	53	55	27.5	8.75
21" Circum.	30	13.3	68	70	29.5	9.39
6.68" Diam.	35	17.1	92	90	31.5	10.03
	40	21.2	112	130	33.5	10.66
	45	25.6	134	145	35.0	11.14
	50	30.4	165	170	36.5	11.62
	55	35.4	189	190	38.0	12.10
	60	40.7	208	215	39.0	12.41
	65	46.4	245	240	40.5	12.89
	70	52.2	277	265	41.5	13.21

(Cont.) Size, Cubic Volume and Board Foot Volume in Pine Poles

Class 5	25	8.6	43	45	25.5	8.12
19" Circum.	30	11.6	55	55	27.5	8.75
6.05" Diam.	35	14.8	75	75	29.0	9.23
	40	18.4	93	100	31.0	9.87
	45	22.2	107	120	32.5	10.35
	50	26.3	137	140	34.0	10.82
Class 6	20	5.2	24	20	21.0	6.68
17" Circum.						
5.41 Diam.	25	7.5	32	35	23.0	7.32
	30	10.0	43	45	25.0	7.96
	35	12.8	62	65	27.0	8.59
	40	15.9	75	85	28.5	9.07
	45	19.3	90	100	30.0	9.55
Class 7	20	4.6	20	15	19.5	6.21
15" Circum.						
4.77 Diam.	25	6.4	27	25	21.5	6.84
	30	8.6	36	35	23.5	7.48
	35	11.1	49	55	25.0	7.96
Class 9	20	3.2	17	10	17.5	5.57
15" Circum.						
4.77" Diam.	25	4.7	24	20	19.5	6.21
	30	6.4	32	25	20.5	6.53
Class 10	20	2.8	8	10	14.0	4.46
12" Circum.						
3.82 Diam.	25	4.0	14	15	15.0	4.77

Forest Farmer Manual, March 1975

AVERAGE WEIGHTS TREATED LONG LEAF YELLOW PINE POLES

CLASS	1	2	3	4	5	6	7	9	10
20 ft. ----	710	564	467	394	330	284	234	202	161
25 ft. ----	990	811	674	573	490	422	344	289	235
30 ft. ----	1,279	1,082	921	784	660	550	454	371	
35 ft. ----	1,568	1,343	1,155	1,004	862	743	646		
40 ft. ----	1,884	1,623	1,403	1,219	1,059	921	807		
45 ft. ----	2,223	1,911	1,664	1,444	1,274	1,114	976		
50 ft. ----	2,585	2,214	1,925	1,687	1,494	1,329	1,169		
55 ft. ----	2,993	2,567	2,200	1,934	1,719	1,563			
60 ft. ----	3,765	3,210	2,740	2,385	2,130	1,965			
65 ft. ----	4,380	3,645	3,070	2,680	2,440				
70 ft. ----	5,040	4,125	3,430	2,980	2,715				
75 ft. ----	5,670	4,620	3,825	3,295					

CONVERSIONS AMONG LOG RULES AND CUBIC VOLUMES FOR SOUTHERN PINE SAWTIMBER

Dbh	Cubic feet to bd. ft.			Doyle to Int	Int to Doyle	Scrib to Int	Int to Scrib	Doyle to Scrib	Scrib to Doyle
	Doyle	Scrib	Int						
In.					Ratios				
10	2.30	4.45	5.90	2.56	0.39	1 325	0.755	1.93	0.52
11	2.70	4.85	6.05	2.24	0.45	1.250	0.800	1.80	0.56
12	3.00	5.10	6.20	2.07	0.48	1.210	0.825	1.70	0.59
13	3.40	5.35	6.35	1.87	0.54	1.185	0.845	1.57	0.64
14	3.70	5.55	6.50	1.76	0.57	1.170	0.855	1.50	0.67
15	4.00	5.70	6.60	1.65	0.61	1.155	0.865	1.43	0.70
16	4.20	5.85	6.70	1.60	0.63	1.140	0.875	1.39	0.72
17	4.40	6.00	6.80	1.54	0.65	1.130	0.885	1.36	0.73
18	4.70	6.15	6.85	1.46	0.69	1.115	0.895	1.31	0.76
19	4.90	6.25	6.90	1.41	0.71	1.105	0.905	1.28	0.78
20	5.10	6.35	6.95	1.36	0.73	1.095	0.915	1.25	0.80
21	5.30	6.45	7.00	1.32	0.76	1.085	0.920	1.22	0.82
22	5.50	6.50	7.00	1.27	0.79	1.080	0.925	1.18	0.85
23	5.70	6.60	7.05	1.24	0.81	1.075	0.935	1.16	0.86
24	5.90	6.65	7.10	1.20	0.83	1.070	0.940	1.13	0.89
25	6.10	6.70	7.15	1.17	0.85	1.065	0.940	1.10	0.91

COMPARISON OF LOG RULES

16' Logs			(From Forestry Handbook)	
Top DIB (inches)	Doyle	Scribner	International	Cubic Ft.
Formula	$(D-4)^2xL$	$79D^2-2D-4$	$0.796D^2-1.375D-1.230$	$(B+b)\frac{L}{2}$
8	16	32	40	7
9	25	42	50	9
10	36	54	65	11
11	49	64	80	13
12	64	79	95	15
13	81	97	115	17
14	100	114	135	20
15	121	142	160	22
16	144	159	180	25
17	169	185	205	28
18	196	213	230	32
19	225	240	260	35
20	256	280	290	39

Approximate Equivalents of Forest Products

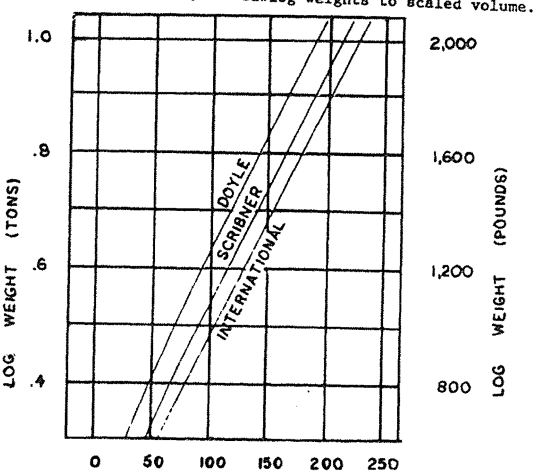
Cubic feet	Board feet	Cords	Cubic Meters (steres)
1	6	-----	0.0283
200	1,000	2	7.25
90	500	1	2.5
35	138	0.25	1

Weight per MBF Scribner Decimal C log rule by species

Species	Average weight per MBF[1] Lbs.	Range[1] Lbs.
Longleaf	15,500	14,215-18,130
Longleaf-loblolly	15,000	
Loblolly	14,900	
Slash	15,100	12,964-16,336
Slash-longleaf	15,100	13,136-16,364
Slash, pond, loblolly, longleaf	15,400	14,017-15,955
Shortleaf	14,700	
Pond	13,770	
Slash-loblolly	14,900	14,097-16,090

[1] Average and range values were derived from many weight sales, and they have been used for actual weight scaling in Southeastern Georgia.
Source: U. S. Army Corps of Engineers. 1965. Selling sawtimber by the pound. Unpublished study.

Relation of southern pine sawlog weights to scaled volume.



(Adapted from Siegel and Row, 1960.)

(1) Volume/Weight Relationship for Loblolly Sawlogs

Log Scaling Diam. Inches	Weight/MBF International 1/4" Rule
6	13,040
7	12,220
8	11,470
9	10,760
10	10,320
11	10,110
12	9,880
13	9,540
14	8,910
15	9,930
16	9,240

(Average pine = 12,666 lbs/MBF)
(Koppers, Inc.)

(2) Cubic foot volume of cordwood (D = average diameter)

Solid volume of rough wood in Cu. Ft. = $4(D-6)$

Stacked volume of rough wood in Cords = $\frac{4(D-6)}{100}$

Pulpwood stumpage value per tree = $\frac{4(D-6)}{100}$ x price/cord

Number of Trees/Standard Cord = $\frac{90}{4(D-6)}$

Weight-Cord-Cubic Foot Relationships

Pine weight - volume conversion factors vary with species, age of stand, and distance from the coast. Thus local conversion factors should be developed for each procurement area. Illustrative of the variations existing are the average estimated weights per 128-cubic foot cord for the major pine type groups:

Type	Green weight per cord
	Lbs.
Loblolly-shortleaf:	
Texas to W. Louisiana	4700
Central Louisiana through the Southeast	5200
Longleaf-slash	5550

A cord of pulpwood from the Midsouth contains more wood now than it did 15 years ago.

Volume of wood per cord of pulpwood in the Midsouth

Region	Year	All species	Pine	Hardwood
			Cubic feet per standard cord	
Midsouth	1950		75	78
Midsouth[1]	1965	81	81	80
East Gulf	1964	80	80	79
West Gulf	1965	82	82	81

[1]East and West Gulf factors are combined in proportion to annual pulpwood production.

In a pile of wood made up of perfectly smooth cylinders of identical diameter, the solid-wood content would be the same regardless of whether the diameter was large or small. But if diameters vary, the solid-wood content increases, because small sticks fill up some of the space between large ones. On the other hand, anything that causes deviation from the cylindrical (crook or roughness, for example), will lessen the solid wood content.

When average diameter of bolts increases, both these causes of variation operate to raise the solid-wood content. This is because the range in diameters in a pile usually becomes greater as average diameter of bolts in the pile increases, and also because large bolts tend to be less crooked and rough than small ones.

Volume Per Square Foot of Basal Area (Int. 1/4 Inch)
(Prism BAF-10) Form Class 79

Ave. DBH	Number Logs Per Average Tree							
	1	1 1/2	2	2 1/2	3	3 1/2	4	
8	57	77	92	109				
9	63	84	102	115	124			
10	70	92	112	126	141			
11	73	95	118	135	151			
12	74	98	122	140	158	168	179	
13	76	102	127	146	166	178	191	
14	77	103	129	150	170	183	197	
15	77	104	130	152	174	190	205	
16	78	104	131	153	176	193	209	
17	79	106	134	160	181	198	217	
18	79	107	136	160	184	201	220	

This table may be used for rough estimates of sawtimber volume per acre (Int. 1/4" Rule) without making log count per point.

(1) Find BA at sample point
(2) Multiply BA by factor for average size tree (DBH and log length)

Pulpwood Volume Per Square Foot B.A. (Standard Cords)
(Prism BAF-10)

Ave. DBH	Number 5-Foot Bolts Per Average Tree											
	1	2	3	4	5	6	7	8	9	10	11	12
4	.06	.09	.13									
5	.07	.10	.13	.17	.20							
6		.10	.13	.17	.20	.23	.26	.29				
7			.13	.16	.19	.23	.26	.29	.32			
8			.13	.16	.19	.22	.25	.28	.31	.35	.38	.41
9				.16	.19	.22	.25	.28	.31	.34	.37	.40
10				.16	.19	.22	.25	.28	.31	.35	.37	.40
11				.15	.19	.21	.25	.28	.31	.34	.37	.40
12				.15	.18	.21	.24	.28	.31	.34	.37	.40
13				.14	.17	.20	.23	.25	.28	.31	.34	.37
14				.15	.18	.21	.24	.27	.30	.34	.37	.40
15							.24	.27	.30	.34	.37	.40

$$\text{Vol./Acre} = \frac{\text{Sum Basal Area/point} \times \text{Factor}}{\text{No. of Points}}$$

Volume Conversion Factors for int. 1/4" Rule (BAF-20)
Form Class 79

Ave. DBH	Number Logs Per Average Tree						
	1	1 1/2	2	2 1/2	3	3 1/2	4
8	573	515	458	401			
9	634	558	509	462	415		
10	697	611	559	477	470		
11	727	636	591	539	506		
12	738	653	611	560	536	480	449
13	759	679	634	585	553	508	477
14	767	685	645	598	567	524	493
15	774	695	652	609	581	543	513
16	773	696	655	612	587	550	523
17	786	710	672	632	604	567	539
18	792	717	679	638	613	575	549

$$\text{Volume per acre} = \frac{\text{Sum of \# logs x Factor}}{\text{No. sampling points}}$$

Factor of 600 for average timber, over estimates in tall timber, underestimates in short timber.

Pulpwood Volume Conversion Factors for Standard Cord
(Prism BAF-10)

Ave. DBH	Number 5-Foot Bolts Per Average Tree										
	1	2	3	4	5	6	7	8	9	10	11	12
4	.56	.46	.43									
5	.69	.51	.45	.42	.40							
6		.51	.45	.42	.40	.38	.37	.37				
7			.44	.41	.39	.38	.37	.36	.35			
8			.43	.40	.38	.37	.36	.35	.35	.35	.34	.34
9				.39	.37	.36	.35	.35	.34	.34	.34	.33
10				.39	.37	.36	.36	.35	.34	.34	.34	.34
11				.38	.37	.36	.35	.35	.34	.34	.34	.33
12				.38	.37	.36	.35	.34	.34	.34	.34	.33
13				.35	.34	.33	.32	.32	.32	.31	.31	.31
14				.37	.36	.35	.35	.34	.34	.34	.34	.33
15							.35	.34	.34	.34	.34	.33

$$\text{Vol/Acre} = \frac{\text{Sum Number 5' Bolts x Factor}}{\text{No. of Points}}$$

Av. Factor for 5' Bolts .37

Vol. from VDF Pub. 58

POLE SPECIFICATIONS:

Minimum diameter at breast height (outside bark) [1/] of trees to meet American National Standard specifications for various classes of southern pine poles

Pole length (feet)	Dist. Butt to Ground Line	Pole Class 1	2	3	4	5	6	7
		Minimum Top Circum. (inches)						
		27	25	23	21	19	17	15
		Minimum Top Diameter (inches)						
		8.6	8.0	7.3	6.7	6.0	5.4	4.8
	Feet	Inches (Dbh-ob)						
20	4	11.2	10.5	9.8	9.0	8.3	7.6	7.1
25	5	12.1	11.4	10.7	9.9	9.2	8.3	7.8
30	5 1/2	13.2	12.3	11.6	10.7	9.9	9.0	8.5
35	6	14.1	13.2	12.3	11.4	10.5	9.8	9.0
40	6	14.8	13.9	13.0	12.1	11.2	10.3	9.6
45	6 1/2	15.6	14.6	13.6	12.7	11.8	10.9	10.1
50	7	16.3	15.2	14.1	13.2	12.3	11.4	10.5
55	7 1/2	16.8	15.7	14.6	13.7	12.7	11.8	---
60	8	17.4	16.3	15.2	14.1	13.0	12.1	---
65	8 1/2	17.9	16.6	15.6	14.6	13.6	---	---
70	9	18.4	17.4	16.3	15.0	13.9	---	---
75	9 1/2	19.0	17.7	16.6	15.6	---	---	---
80	10	19.5	18.3	17.0	15.9	---	---	---
85	10 1/2	19.9	18.6	17.4	---	---	---	---
90	11	20.3	19.2	17.7	---	---	---	---
95	11	20.6	19.5	18.1	---	---	---	---

1/ D.B.H. = $\frac{\text{Minimum Circumference 6' from butt}}{.88 \times 3.1416}$

Source: Hawes, E. T. 1947. A method of determining southern pine pole classes from d.b.h. Jour. Forestry 45: 204,205 illus.

HARDWOOD LOG GRADES FOR STANDARD LUMBER

Grading of logs is not so difficult as it appears although it does require great care to make sure that no hidden defects are overlooked. After acquiring experience, the grading of the log may be made while the volume is calculated. Even in the logs where the grading cannot be made immediately, it is often necessary to design the different cuttings. Usually measurements taken to determine whether the log will produce the minimum size required per cut, are sufficient to determine the grading. Grade the logs in standing trees by following the following rules and guides:

Rules for Grading Hardwood Logs (Standing Trees)

1. Grade all logs in tree, third best face.
2. Grade as logs or half logs (log = 16 feet; 1/2 log = 8 feet).
3. End defects of logs are not taken into consideration.
4. Grade all logs to the top cutoff point.
5. Do not grade the long-butt or total cull portion of a log, but do grade the remainder when equal to or more than 8 feet.
6. Do not grade logs that are obvious culls, but do tally them according to their position in the tree. Example: 1 for the first log, 2 for the second, etc.
7. Small bark distortion is a defect in logs whose diameter without bark (D.i.b.) is less than 15".

HARDWOOD LOG GRADES

Grade Factors	Butts	Grade 1 Butts & Uppers	Grade 2 Butts & Uppers	Grade 3 Butts & Uppers
Diam (Min)	13"-15"	16-19" 20"	11"	8"
Approx DBH	16"	20" 25"	14"	10"
Lgth (Min)	10'	10'	8-11' 12'	8'
Clear Cut'gs (3rd best faces) Length (Min)	7'	5' 3'	3'	2'
Number	2	2	2 3	unlimited
Clear Lgths in 16'	13'-4"	13'-4"	10'-8"	8-0"
Sweep	15%	15%	30%	50%
Cull	40%	40%	50%	50%

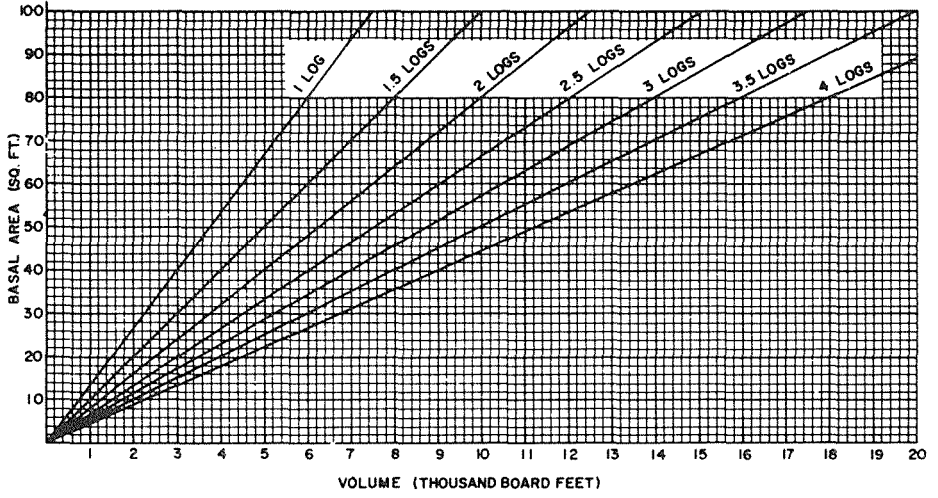
EXCEPTIONS: Ash & Bass 12" DIB for grade 1 butts
Grade 2 10" DIB must be grade 1 surface quality
Grade 2 11" DIB limited to two cuttings

Developed from FPL - D-1737

QUICK CRUISE COMPUTER

(VOLUME-BOARD FEET - INT.)
(1 LOG = 16 FT)

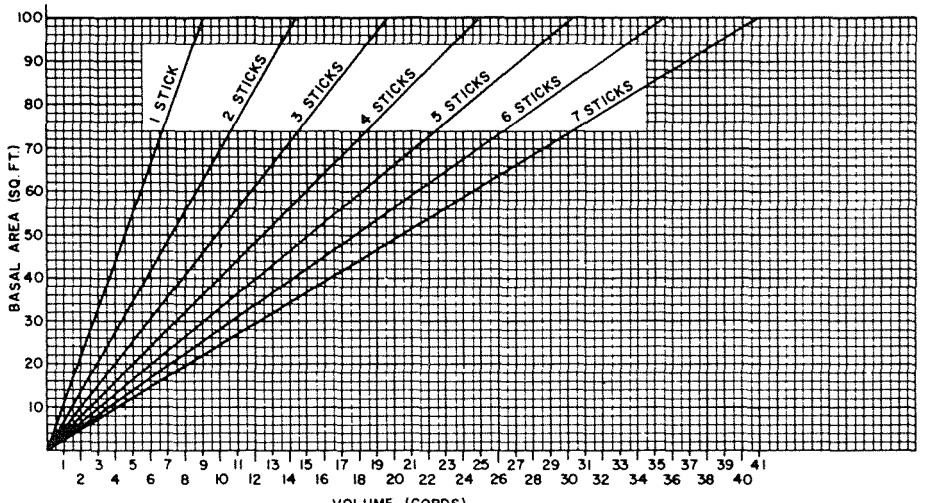
NA - S & PF
FOREST SERVICE
USDA



QUICK CRUISE COMPUTER

VOLUME - CORDS
(1 STICK = 8 FT.)

NA - S & PF
FOREST SERVICE
USDA

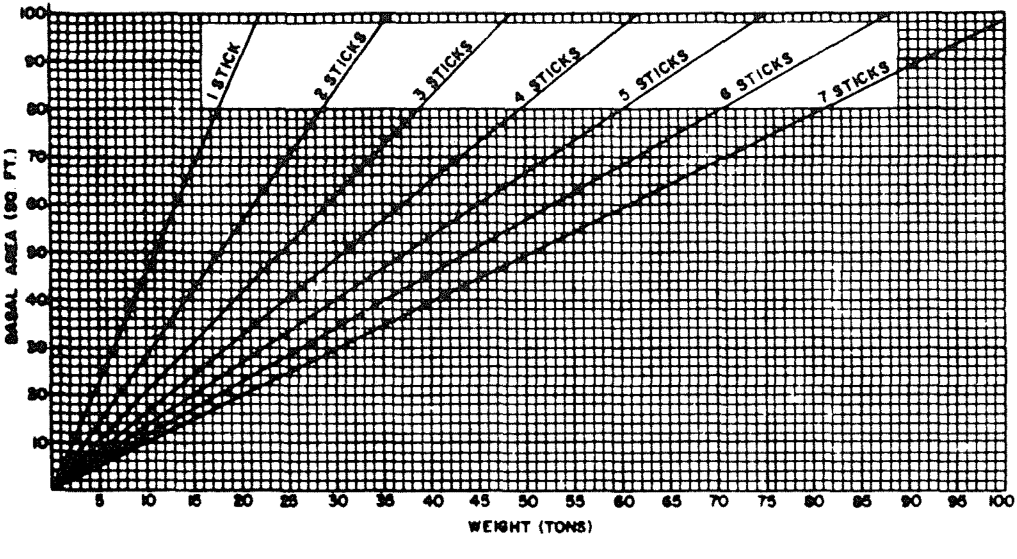


QUICK CRUISE COMPUTER

(WEIGHT - TONS - 2.5 TONS PER CORD)

(1 STICK = 8 FT.)

NA - S & PF
FOREST SERVICE
USDA



GROWTH CALCULATION AND PROJECTION

Use the following method to determine the growth percent using basal area. This method can also be used to project basal area, diameters and volume.

Procedure: Use a prism, bark gauge and a diameter tape to obtain growth information from a representative sample of trees (preferably all the trees within prism range at pre-selected points; for example, every fifth point).

The following information is obtained from each tree:

a. Radial bark thickness

b. Diameter at breast height (D.B.H. outside bark)

c. Radial growth during last 5 years (have the data or estimate it)

D.I.B. (D. without bark) = D.O.B. (D. with bark) - 2 X radial bark thickness.

d.i.b. = D.I.B. - 2 X radial growth during last 5 years

The term: $\sum \frac{(d.i.b.)^2}{D.I.B.}$ is the ratio of basal area 5 years ago to present basal area.

Example:

Tree No.	D.O.B.	D.I.B.	d.i.b.	$\frac{d.i.b.}{D.I.B.}$	$\frac{(d.i.b.)^2}{D.I.B.}$
1	8.4	7.6	5.8	.763	.582
2	6.7	6.0	4.0	.667	.445
3	10.2	9.3	7.8	.839	.704
4	12.0	11.0	9.6	.873	.762
5	9.6	8.7	6.8	.782	.612
			TOTAL		3.105

Where:

D.O.B. = Present diameter at breast height (outside bark)

D.I.B. = Present diameter at breast height less bark

d.i.b. = D.I.B. 5 years ago

$\sum$ = the sum of

Continued next page

Cont. Growth Calculation and Projection

$$\% \text{ gross growth} = 1 - \frac{\sum \frac{(\text{d.i.b.})^2}{\text{D.I.B.}}}{\text{Total trees in sample}}$$

$$\% = 1 - \frac{3.105}{5} = 1 - .621 = .379$$

% = .379 or 37.9% (for 5 years)

$$\% \text{ annual growth} = \frac{37.9}{5 \text{ years}} = 7.58\%$$

Present		Projected to next 5 years
(Basal area) (Volume) (Average Diameter)	X 37.9% =	(Basal Area Increase) (Volume Increase) (Average Diameter Increase)

Example: Estimated volume at end of 5 years:

Present volume/acre = 1450 board feet

% gross growth in 5 years = 37.9%

Increase in volume in 5 years 550 board feet
Present volume/acre +1450 board feet

Volume/acre at end of 5 years 2000 board feet

DOLLAR VALUES OF MERCHANTABLE WOOD FOR DIFFERENT
MEASUREMENT UNITS COMPARED TO STANDARD CORD (128 cu. ft.)

Measurement Unit	(values per cord) $4	$6	$8	$10	$12	$14	$16	$18	$20	$24	$28	$36	$44
Unit (160 cu.ft.)	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	30.00	35.00	45.00	55.00
MBF Scribner*													
10" trees	15.20	22.80	30.40	38.00	45.60	53.20	60.80	68.40	76.00	91.20	106.40	136.80	167.20
12" trees	13.60	20.40	27.20	34.00	40.80	47.60	54.40	61.20	68.00	81.60	95.20	122.40	149.60
14" trees	12.00	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00	72.00	84.00	108.00	132.00
MBF Int. 1/4"*													
10" trees	13.60	20.40	27.20	34.00	40.80	47.60	54.40	61.20	68.00	81.60	95.20	122.40	149.60
12" trees	11.60	17.60	23.20	29.00	34.80	40.60	46.40	52.20	58.00	69.60	81.20	104.40	127.60
14" trees	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	60.00	70.00	90.00	110.00
MBF Doyle*													
10" trees	27.20	40.80	54.40	68.00	81.60	95.20	108.80	122.40	136.00	163.20	190.40	244.80	299.20
12" trees	24.80	37.20	49.60	62.00	74.40	86.80	99.20	111.60	124.00	148.80	173.60	223.20	272.80
14" trees	18.00	27.00	36.00	45.00	54.00	63.00	72.00	81.00	90.00	108.00	126.00	162.00	198.00

Data from Southeastern Forest Experiment Station

*Entire Tree (Includes Top Wood)

DOLLARS PER CORD TO CENTS PER HUNDRED POUNDS

HARDWOOD			DOLLARS	PINE		
128' Cord 5400 lbs.	160' Cord 6750 lbs.	180' Cord 7600 lbs.	Per Unit $	128' Cord 5300 lbs.	160' Unit 6625 lbs.	180' Unit 7450 lbs.
1.9¢100#	1.5	1.3	1.00	1.9	1.5	1.3
2.3	1.9	1.6	1.25	2.4	1.9	1.7
2.8	2.2	2.0	1.50	2.8	2.3	2.0
3.2	2.6	2.3	1.75	3.3	2.6	2.3
3.7	3.0	2.6	2.00	3.8	3.0	2.7
4.2	3.3	3.0	2.25	4.2	3.4	3.0
4.6	3.7	3.3	2.50	4.7	3.8	3.4
5.1	4.1	3.6	2.75	5.2	4.2	3.7
5.6	4.4	3.9	3.00	5.7	4.5	4.0
6.0	4.8	4.3	3.25	6.1	4.9	4.4
6.5	5.2	4.6	3.50	6.6	5.3	4.7
6.9	5.6	4.9	3.75	7.1	5.7	5.0
7.4	5.9	5.3	4.00	7.5	6.0	5.4
7.9	6.3	5.6	4.25	8.0	6.4	5.7
8.3	6.7	5.9	4.50	8.5	6.8	6.0
8.8	7.0	6.3	4.75	9.0	7.2	6.4
9.3	7.4	6.6	5.00	9.4	7.5	6.7
9.7	7.8	6.9	5.25	9.9	7.9	7.0
10.2	8.1	7.2	5.50	10.4	8.3	7.4
10.6	8.5	7.6	5.75	10.8	8.7	7.7
11.1	8.9	7.9	6.00	11.3	9.1	8.1
11.6	9.3	8.2	6.25	11.8	9.4	8.4
12.3	9.6	8.6	6.50	12.2	9.8	8.7
12.5	10.0	8.9	6.75	12.7	10.2	9.1
13.0	10.4	9.2	7.00	13.2	10.6	9.4
13.4	10.7	9.5	7.25	13.7	10.9	9.7
13.9	11.1	9.9	7.50	14.2	11.3	10.1
14.3	11.5	10.2	7.75	14.6	11.7	10.4
14.8	11.9	10.5	8.00	15.1	12.1	10.7
15.3	12.2	10.9	8.25	15.6	12.5	11.1
15.7	12.6	11.2	8.50	16.0	12.8	11.4
16.2	13.0	11.5	8.75	16.5	13.2	11.7
16.7	13.3	11.8	9.00	17.0	13.6	12.1
17.1	13.7	12.2	9.25	17.5	14.0	12.4
17.6	14.1	12.5	9.50	17.9	14.3	12.8
18.1	14.4	12.8	9.75	18.4	14.7	13.1
18.5	14.8	13.2	10.00	18.9	15.1	13.4

H. R. Hendricks , Wood Procurement Nov. 3, 1963

Average Value Per Tree - At Various Prices Per Cord

D.b.h.	Average Volume	Price per Cord - Dollars								
		2	4	6	8	10	12	14	16	18
Inches	-Cords-	Value per tree - Dollars								
5	.02	.04	.08	.12	.16	.20	.24	.28	.32	.36
6	.04	.08	.16	.24	.32	.40	.48	.56	.64	.72
7	.06	.12	.24	.36	.48	.60	.72	.64	.96	1.08
8	.09	.18	.36	.54	.72	.90	1.08	1.26	1.44	1.62
9	.12	.24	.48	.72	.96	1.20	1.44	1.68	1.92	2.16
10	.16	.32	.64	.96	1.28	1.60	1.92	2.24	2.58	2.88
11	.20	.40	.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60
12	.25	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
13	.30	.60	1.22	1.80	2.40	3.00	3.60	4.20	4.80	5.40
14	.36	.72	1.44	2.16	2.88	3.60	4.32	5.04	5.76	6.48

COMPOUND INTEREST FACTORS
VALUE OF $1 (Computed annually) AT THE END OF A PERIOD OF n YEARS EARNING r % ANNUAL INTEREST

3%	6%	9%	YEARS	12%	15%	18%
.....Dollars.....				.....Dollars.....		
1.030	1.060	1.090	1	1.120	1.150	1.180
1.060	1.123	1.188	2	1.254	1.322	1.392
1.092	1.191	1.295	3	1.404	1.520	1.643
1.125	1.262	1.411	4	1.573	1.749	1.938
1.159	1.338	1.538	5	1.762	2.011	2.287
1.194	1.418	1.677	6	1.973	2.313	2.699
1.229	1.503	1.828	7	2.210	2.660	3.185
1.266	1.593	1.992	8	2.475	3.059	3.758
1.304	1.689	2.171	9	2.773	3.517	4.435
1.343	1.790	2.367	10	3.105	4.045	5.233
1.384	1.898	2.580	11	3.478	4.652	6.175
1.425	2.012	2.812	12	3.895	5.350	7.287
1.468	2.132	3.065	13	4.363	6.152	8.599
1.512	2.260	3.341	14	4.887	7.075	10.147
1.557	2.396	3.642	15	5.473	8.137	11.973
1.604	2.540	3.970	16	6.130	9.357	14.129
1.652	2.692	4.327	17	6.866	10.761	16.672
1.702	2.854	4.717	18	7.689	12.375	19.673
1.753	3.025	5.141	19	8.612	14.231	23.214
1.806	3.207	5.604	20	9.646	16.366	27.393
1.860	3.399	6.108	21	10.803	18.821	32.323
1.916	3.603	6.658	22	12.100	21.644	38.142
1.973	3.819	7.257	23	13.522	24.891	45.007
2.032	4.048	7.911	24	15.178	28.625	53.109
2.093	4.291	8.623	25	17.000	32.918	62.668
2.156	4.549	9.399	26	19.040	37.856	73.948
2.221	4.822	10.245	27	21.324	43.535	87.259
2.287	5.111	11.167	28	23.883	50.065	102.966
2.356	5.418	12.172	29	26.749	57.575	121.500
2.427	5.743	13.267	30	29.959	66.211	143.370
2.813	7.686	20.413	35	52.799	133.175	327.997
3.262	10.285	31.409	40	93.050	267.863	750.378
3.781	13.764	48.327	45	163.987	538.769	1716.683
4.383	18.420	74.357	50	289.002	1083.657	3927.356
5.082	24.650	114.408	55	509.320	2179.622	8984.841
5.891	32.987	176.031	60	897.596	4383.998	20555.139
6.829	44.144	270.845	65			
7.917	59.075	416.730	70			
9.178	79.056	641.190	75			
10.640	105.795		80			
12.335	141.578		85			
14.300	189.464		90			
16.578	253.546		95			
19.218	339.302		100			

COMPOUND-INTEREST FORMULAS

1. End value of initial sum after n years

$$Vn = Vo\ (1 + r)^n$$

2. Initial value of end value

$$Vo = \frac{Vn}{(1 + r)^n}$$

3. Rate of interest earned on initial sum

$$r = 100 \left[\left(\frac{Vn}{Vo} \right)^{1/n} - 1 \right]$$

4. Amount of interest earned

$$Rn = Vo \left[(1+r)^n - 1 \right]$$

5. Initial value of a perpetual annual payment

$$Vo = a + \frac{a}{r}$$

6. Initial value of terminable series of annual payments

$$Vo = a + \frac{a}{r} \frac{(1+r)^n - 1}{(1+r)^n}$$

7. End value of terminable series of annual payments

$$Vn = \frac{a}{r} \left[(1 + r)^n - 1 \right]$$

8. Present worth of land

$$\text{Present Worth} = \frac{\text{Net value at end of rotation}}{(1 + r)^t - 1}$$

Legend

Vn = end value
r = rate of interest
Vo = initial value
Rn = amount of interest ($)
n = number of years
a = annual payment
t = length of rotation

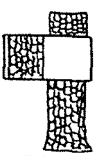
Use of Wedge Prism

The prism is a piece of a wedge-shaped rectangular glass which causes a distortion of light, displacing the image towards the thinner edge. It is used to estimate the basal area of a stand.

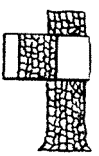
Basal Area

1. Hold prism (not your eye) over the selected point at a comfortable distance from the eye, with the long side horizontal. Hold prism with right hand by lower part of the thicker edge.

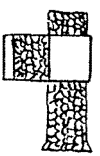
2. With one eye closed, point with the upper part of the prism so as to divide the tree in question at breast height. Refraction of light through the prism will cause the portion of the tree below breast height to appear separated. Count as 1 all the trees whose figures are superimposed, as 1/2, or measure for accuracy those which touch only at the edge. If they do not touch each other they are not counted.



Not counted



Count: 1



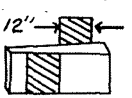
Count: 1/2 or measure

3. Turn in a circle, checking each visible tree, making sure not to count the same tree twice.

4. The number of trees counted, multiplied by basal area conversion factor of prism gives us the basal area per stand acre.

$$\text{BA/Acre} = \frac{\text{Total trees counted x BAF of prism}}{\text{Number of samples}}$$

Basal Area Factor. Set up a target exactly one foot wide. For an approximate 10 BAF prism, sight about 33 feet from target. Move toward or away from target until right edge of target (as seen in prism) jibes with left edge of target (just above prism). Measure exact distance prism to target. Take several readings and use average. Calculate BAF by formula --



$$\text{BAF} = \frac{43560}{1+4\left(\frac{D}{W}\right)^2}$$

D is distance prism to target
W is width of target

Where target "W" is exactly 1 foot wide

$$\text{or: BAF} = \frac{43560}{1+4(D)^2}$$

$$\text{or: BAF} = 10{,}890\left(\frac{W}{D}\right)^2$$

A close approximation

Plot Radius Factor. The distance from a sampling point to a borderline tree equals DBH times PRF. For a BAF 10.0 prism the PRF is 2.75. A 10-inch tree times 2.75 gives a critical distance of 27.5 feet, a 14-inch tree is 38.5 feet, etc. The number of trees per acre that each tallied 10-inch tree represents is 18.35; each 14-inch tree is 9.35, etc.

The basic formula: $PRF = \sqrt{\frac{75.625}{BAF}}$

Borderline Trees. Always measure borderline trees for more than a casual check on basal area. A short cut method counts borderline trees as 1/2.

1. Measure horizontal distance from sample point to center of tree at BH.
2. Get DBH.
3. Multiply DBH by prism PRF. When this product is more than taped distance, the tree is "In".

Example: (PRF is 2.75, DBH 10.0")
2.75 X 10.0 = 27.5 feet, taped distance is 27.2 feet; tree is "In".

Precautions

1. Prism must be in center of plot, not the eye. Walk around the prism; do not stand in one place and move the prism around you.

2. Always hold face of prism at right angle to eyesight, horizontally and vertically. (except for leaning trees and when correcting for slopes).

3. For leaning trees move prism forward and backward on its vertical axis according to the inclination of the tree trunk.

4. Correct for slope by rotating prism to the same amount of slope between the prism and the tree, but at right angles to the eye.

5. If there is an object between you and the tree to be checked, move one step sideways, keeping a constant distance between you and the tree.

6. In dense stands be careful not to confuse or incorrectly associate the trunks. (If a tree is "In" above the brush, it is "In" at BH).

7. Remember that each diameter size has its own plot radius, the radius varies directly with the tree diameter. Therefore, the largest and most valuable trunks are usually sampled more intensely than the smaller trunks.

--The prism helps to train the eye to estimate the basal area of stands, use it.

VOLUME PER ACRE

Volume: Volume is related to basal area and merchantable or total tree height. The average basal area per acre in each height class multiplied by the volume factor gives us the volume per acre. The factors can be for any scale - board feet by any rule, cubic feet, or cords. If the available factors cannot be relied upon, they can be developed as necessary.

VOLUME FACTORS

Estimate the volume per acre by multiplying the number of trees measured in each length class by the following factors:*

PULPWOOD			SAWLOGS				
Merchantable Height	Cubic Vol. (With Bark)	Cords (With Bark)	Merchantable Height 1/	Int. 1/4	Scribner	Doyle	Cubic (Without Bark)
10	7	.08	1	7	6	4	1.2
20	14	.16	2	13	11	8	2.0
30	20	.22	3	18	16	2	2.7
40	26	.29	4	23	20	15	3.4
50	31	.34	5	28	25	21	4.0
60	36	.40					
70	39	.43					

$V = 10 \frac{\text{Sum of Products}}{\text{Number of Points}}$ $\quad$ $V = 100 \frac{\text{Sum of Products}}{\text{Number of Points}}$

* For a 10 factor prism.
1/ Merchantable height is in 16 foot logs.

LSU Forestry Note #16, June 1957

Cont. Volume per Acre

Local Volume Factors: Pulpwood factors are fairly consistent. Sawlog factors are not very reliable in different localities. The procedure to prepare local factors is as follows:

1. Write down the sample trees according to diameter class and number of logs. (The total of trees tallied divided by the number of points or samples.)

2. Obtain the number of plots per acre from the table at page 54.

3. Multiply in order to obtain trees per acre.

4. Write down volume for each tree.

5. Multiply to obtain volume per acre.

6. Total volume per acre for each length class.

7. Write down the basal area per acre (trees per plot for each length class multiplied by the basal area factor).

8. Volume factor is the volume per acre divided by basal area per acre.

Refer to example in next page.

EXAMPLE: Basal Area Factor: 10

Dbh Class	Trees Per Point 1/ 1-log	2-log	3-log	Plots 2/ per acre	Trees per acre 3/ 1-log	2-log	3-log	Volume Per Tree 4/ 1-log	2-log	3-log	Volume Per Acre 5/ 1-log	2-log	3-log
10	0.136	0.136	--	18.349	2.5	2.5	--	40	60	70	100	150	--
12	0.785	0.628	0.157	12.739	10.0	8.0	2.0	50	90	120	500	720	240
14	0.428	0.534	0.107	9.355	4.0	5.0	1.0	80	130	170	320	650	170
16	0.140	0.419	0.140	7.163	1.0	3.0	1.0	100	170	230	100	510	230
Total	1.489	1.717	0.404					Boardfeet Per acre 6/			1020	2030	640
								Basal Area Per Acre 7/			14.89	17.17	4.04
								Volume Factor 8/			68.5	118.2	158.4

1/ Foot note 1-8 on previous page

BASAL AREA TABLE - AREA OF CIRCLE IN SQUARE FEET

DIAMETER IN TENTHS OF INCHES

DIAMETER

Inches	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
	Area in Square Feet									
1	0.005	0.007	0.008	0.009	0.011	0.012	0.014	0.016	0.018	0.020
2	.022	.024	.026	.029	.031	.034	.037	.040	.043	.046
3	.049	.052	.056	.059	.063	.067	.071	.075	.079	.083
4	.087	.092	.096	.101	.106	.110	.115	.120	.126	.131
5	.136	.142	.147	.153	.159	.165	.171	.177	.183	.190
6	.196	.203	.210	.217	.223	.230	.238	.245	.252	.260
7	.267	.275	.283	.291	.299	.307	.315	.323	.332	.340
8	.349	.358	.367	.376	.385	.394	.403	.413	.422	.432
9	.442	.452	.462	.472	.482	.492	.503	.513	.524	.535
10	.545	.556	.567	.579	.590	.601	.613	.624	.636	.648
11	.660	.672	.684	.696	.709	.721	.734	.747	.759	.772
12	.785	.799	.812	.825	.839	.852	.866	.880	.894	.908
13	.922	.936	.950	.965	.979	.994	1.009	1.024	1.039	1.054
14	1.069	1.084	1.100	1.115	1.131	1.147	1.163	1.179	1.195	1.211
15	1.227	1.244	1.260	1.277	1.294	1.310	1.327	1.344	1.362	1.379
16	1.396	1.414	1.431	1.449	1.467	1.485	1.503	1.521	1.539	1.558
17	1.576	1.595	1.614	1.632	1.651	1.670	1.689	1.709	1.728	1.748
18	1.767	1.787	1.807	1.827	1.847	1.867	1.887	1.907	1.928	1.948
19	1.969	1.990	2.011	2.032	2.053	2.074	2.095	2.117	2.138	2.160
20	2.182	2.204	2.226	2.248	2.270	2.292	2.315	2.337	2.360	2.382
21	2.405	2.428	2.451	2.474	2.498	2.521	2.545	2.568	2.592	2.616
22	2.640	2.664	2.688	2.712	2.737	2.761	2.786	2.810	2.835	2.860
23	2.885	2.910	2.936	2.967	2.986	3.012	3.038	3.064	3.089	3.115
24	3.142	3.168	3.194	3.221	3.247	3.274	3.301	3.328	3.355	3.382

BASAL AREA AND PLOTS PER ACRE

DBH Inches	Basal Area Sq. Feet	Plots (trees) Per Acre BAF = 10	DBH Inches	Basal Area Sq. Feet	Plots (trees) Per Acre BAF = 10
4	.087	114.94	18	1.767	5.66
5	.136	73.53	19	1.969	5.08
6	.196	51.02	20	2.182	4.58
7	.267	37.45	22	2.640	3.79
8	.349	28.65	24	3.142	3.18
9	.442	22.26	26	3.69	2.71
10	.545	18.35	28	4.28	2.34
11	.660	15.15	30	4.91	2.04
12	.785	12.74	32	5.59	1.79
13	.992	10.08	34	6.31	1.58
14	1.069	9.35	36	7.07	1.41
15	1.227	8.15	38	7.88	1.27
16	1.396	7.16	40	8.73	1.14
17	1.576	6.35			

For a prism calibrated to a BAF = 10, a tree with a DBH of 10 inches represents a plot of $\frac{1}{18.35}$ of an acre.

For other prisms calculate the plots per acre by using this formula:

$$\text{Plots per Acre} = \frac{\text{BAF of Prism}}{\text{Basal Area}}$$

To obtain Basal Area, multiply $(\text{DBH})^2$ by .00545

Example No. 1: (10") x .00545 = .545 sq.ft.

No. 2: $(16")^2$ x .00545 = 1.395 sq. ft.

PLOT RADIUS LIMITS

The plot radius factor (PRF) for prism with basal area factor 10 is 2.75. For your own prism (other than BAF-10) calculate PRF and fill in blank column below. Use for trees of any size to determine if tree is in or out of plot. Select from table for desired DBH and sum up to get limit in feet. MOVE the decimal as needed.

	Point Limits in Feet	
DBH	BAF-10	BAF----
1	2.75	
2	5.50	
3	8.25	
4	11.00	
5	13.75	
6	16.50	
7	19.25	
8	22.00	
9	24.75	
10	27.50	

Example: For 12.8" DBH tree

	DBH	Limit
	10.0	27.5
	2.0	5.5
	.8	2.2
Total	12.8	35.2 FEET

or 12.8 (2.75) = 35.2

STATISTICS FOR PRESCRIPTIONS

Statistics are numerical data about a subject or a name applied to analysis of the reliability of statistical information by sampling.

The person who analyzes the forest land statistics commonly needs only 6 items - - Mean, Standard Deviation, Standard Error, Limit of Error, Coefficient of Variation, and Number of Plots to Sample a Stand to a Desired Accuracy.

Mean - M or average. A total of all sample counts divided by the number of samples.

$$M = \frac{\text{(Sum of sample counts)}}{\text{N (No. of samples)}}$$

Standard Deviation - SD. A statistician's measure of the spread between the individual sample from the mean. The SD is just a tool in calculating error, CV, and N.

$$SD = \sqrt{\frac{\Sigma(Dev)^2}{n-1}}$$

Standard Error - SE. A statistician's stepping stone toward determination of LE.

$$SE = \frac{SD}{\sqrt{n}}$$

Limit of Error - LE. We cannot calculate the actual volume and cannot know the exact error. We calculate a LE for a selected probability. We might say "using gambling odds of 67 out of 100, (2 out of 3), we have a mean volume of 20 cords per acre, plus or minus 2 cords." The Mean is 20, the Standard Error is ±2, and the Limit of Error is .10 or 10%. Increasing the gambling odds to 95 out of 100 doubles the LE. (20%). For odds of 99 out of 100 the LE triples (30%).

$$LE = \frac{SE}{M}$$

Coefficient of Variation - CV. This describes the relative uniformity of the stand. The CV is our most important statistical term. For planted stands the CV may vary .10 to .30 (10% - 30%). Natural stands may vary from about .30 to over 1.00. Different stands with the same CV require the same number of samples to produce means of equal accuracy, regardless of the areas of these stands. The CV comes from the SD and the calculated average or Mean.

$$CV = \frac{SD}{M}$$

Plots Needed to Sample a Stand to a Desired Accuracy. The number of samples (N) has a basic relationship with CV, LE, and the probability.

$$N = \frac{(t)^2\ (CV)^2}{(LE)^2}$$

"t" is probability or gambling odds. Use "1" for "t" for one SD where values involved in the cruise are low and when we can be satisfied with a 2 times out of 3 chance of arriving at a figure that will vary within one SD plus or minus from the Mean.

Use "2" for "t" for more accuracy. This variation of 2 SD's plus or minus makes gambling odds of 95 in 100 that we'll not exceed 2 Standard Deviations. This will take 4 times as many samples as for 1 SD. Here's an example --

--To make a cruise to ± 10% LE with a gambling chance of ± 2 SD (95 times in 100) CV = 30%.

Use:

$$N = \frac{(2)^2\ (.30)^2}{(.10)^2} = \frac{4\ (.09)}{.01} = 36 \text{ Plots}$$

For 1 SD, $(t)^2 = 1$ and N would be 9 plots.
For 3 SD, $(t)^2 = 9$ and N would be 81 plots.
If CV were 15%, N would be one-quarter as many.
If SD were 1 and LE were .20, N would be 9 plots.

Example Tree counts on 9 sampling points) --

Point No.	Tree Count	Deviation From Mean	$(Dev)^2$
1	3	2	4
2	3	2	4
3	10	5	25
4	5	0	0
5	5	0	0
6	4	1	1
7	3	2	4
8	5	0	0
9	8	3	9
n = 9	9/46		$\Sigma(D^2) = 47$

M = 5.1 (call it 5)

$$SD(\text{Std. Dev.}) = \sqrt{\frac{\Sigma(D^2)}{n-1}} = \sqrt{\frac{47}{8}} = 2.42$$

$$\text{SE (Std. Error)} = \frac{SD}{\sqrt{n}} = \frac{2.42}{\sqrt{9}} = .81$$

$$\text{LE (Limit of Error)} = \frac{SE}{M} = \frac{0.81}{5} = .16 = 16\%$$

$$\text{CV (Coef. of Var.)} = \frac{SD}{M} = \frac{2.42}{5} = .48 = 48\%$$

N (No. of Plots):

$$N \text{ (For 1 SD)} = \frac{(1)^2 (CV)^2}{(\% \text{ Acc})^2} = \frac{(.48)^2}{(.10)^2} = 23 \text{ Plots}$$

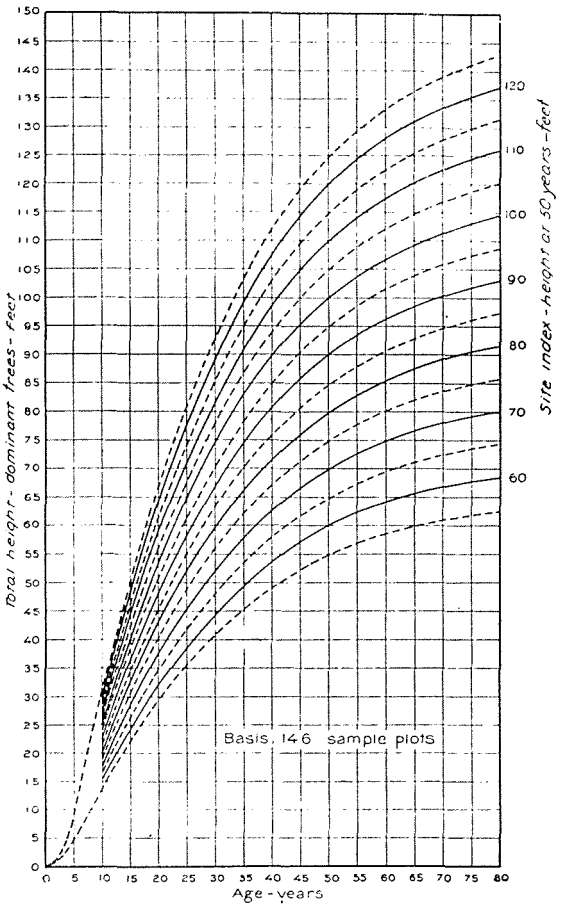
$$N \text{ (For 2 SD)} = \frac{(2)^2 (CV)^2}{(\% \text{ Acc})^2} = \frac{4x.23}{.01} = 92 \text{ Plots}$$

$$N \text{ (For 1 SD, } \pm 20\%) = \frac{(CV)^2}{(\% \text{ Acc})^2} = \frac{.23}{.04} = 6 \text{ Plots}$$

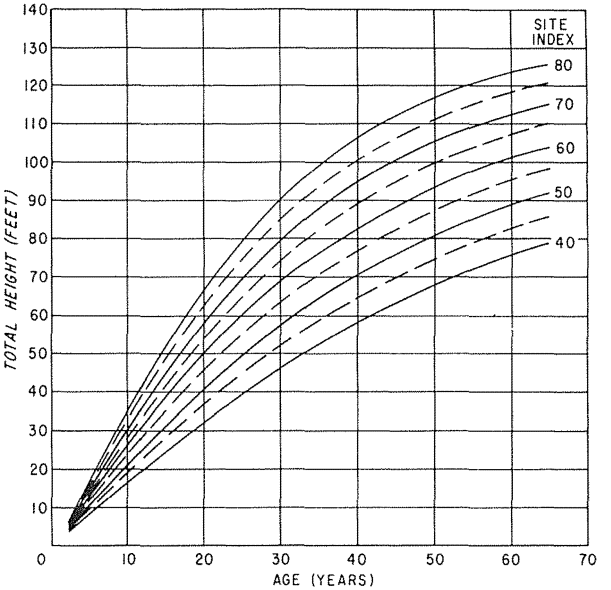
NO. OF SAMPLES TO BE TAKEN FROM INFINITE POPULATION = N

	Specified % Limit - SE			
CV%	± 1-1 1/2%	± 5%	± 10%	± 20%
	N			
10	45	4	1	1
20	178	16	4	1
30	400	36	9	3
40	712	64	16	4
50	1,112	100	25	7
60	1,600	144	36	9
70	2,178	196	49	13
80	2,845	256	64	16
90	3,600	324	81	21
100	4,445	400	100	25
150	10,000	900	225	57

Loblolly Pine



Height-growth classification for second-growth loblolly pine. Reproduced from USDA Forest Service Mis. Publication No. 50.

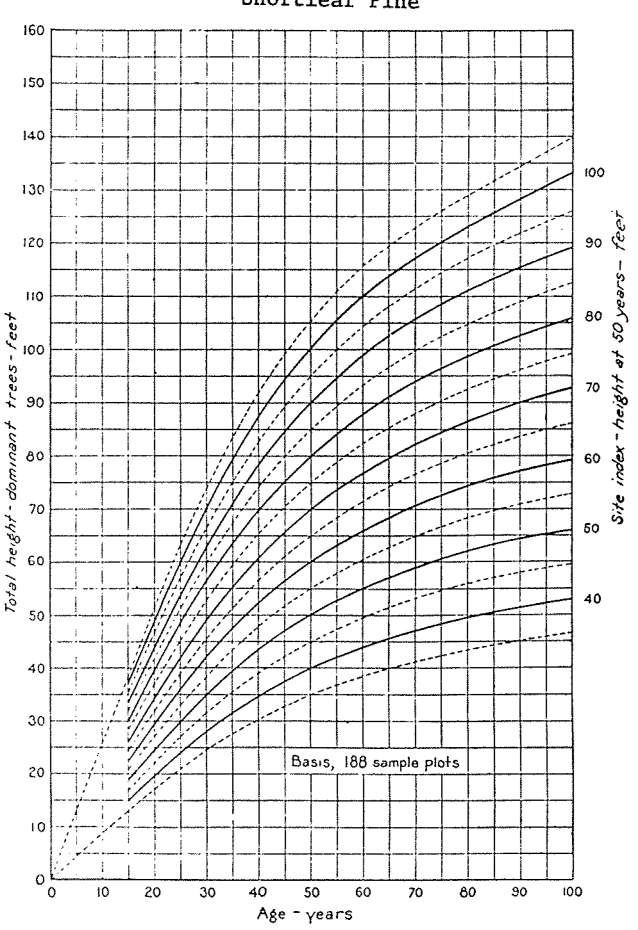


.--Site index curves for loblolly pine at index age 25 years in the Coastal Plain of Virginia, North Carolina, and South Carolina. (These curves are based on stem analysis of 40 dominant trees in the middle and lower Coastal Plain.)

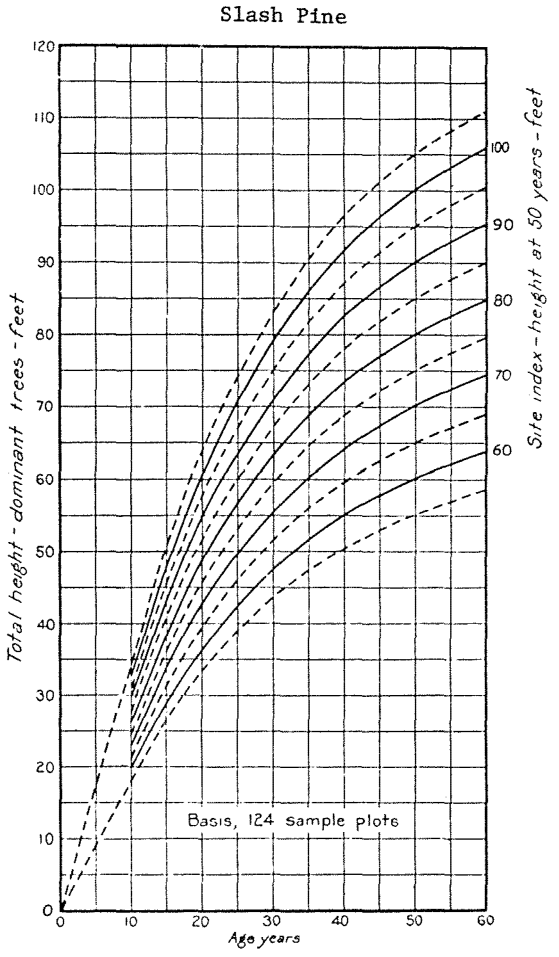
TEST AND COMPARISON OF SITE INDEX CURVES

Seventy-four permanent growth plots in another study provided independent data for testing our new site index curves with those of Schumacher and Coile (1960). We chose the Schumacher-Coile curves for purposes of comparison because they are widely used in estimating growth and yield of loblolly pine in the Southeastern Coastal Plain. When the growth plots were established in 1949, they ranged in age from 16 to 50 years and in site index (age 50) from 63 to 119 feet. Measurements of these 74 plots at 5-year intervals for a 20-year period furnished 364 separate estimates of age and height.

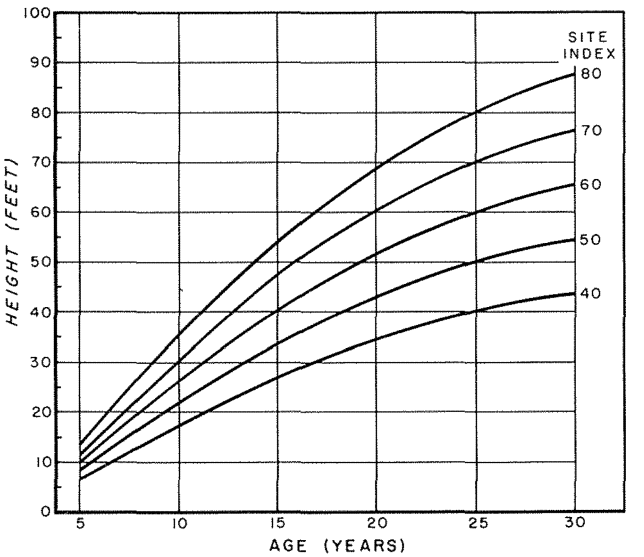
Reproduced from USDA For. Ser. Res. Paper SE-115, June 1974.



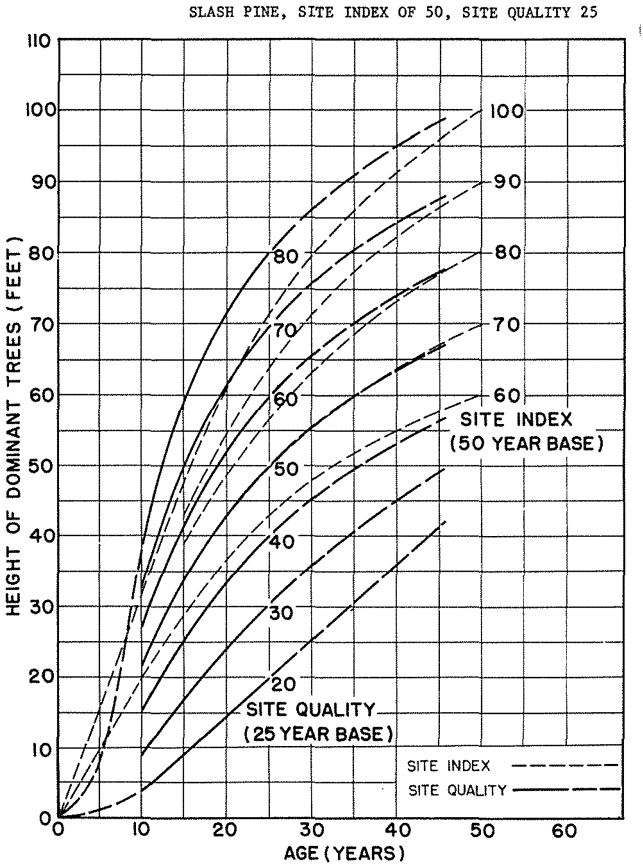
Height-growth classification for second-growth shortleaf pine. Reproduced from USDA Forest Service Misc. Pub. No. 50.



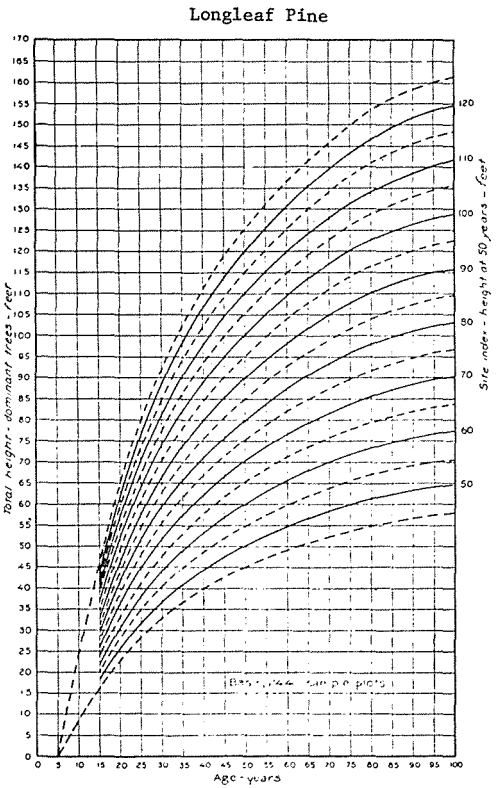
Height-growth classification for second-growth slash pine. Reproduced from USDA Forest Service Misc. Publication No. 50.



—*Site index curves for slash pine in the West Gulf.*

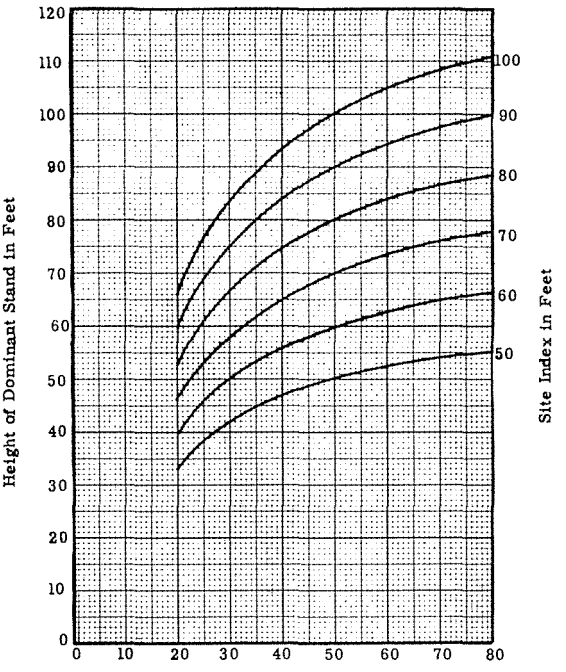


Comparison of Site Index Curves For Second Growth Slash Pine with Site Quality Curves For Slash Pine Plantations in Florida



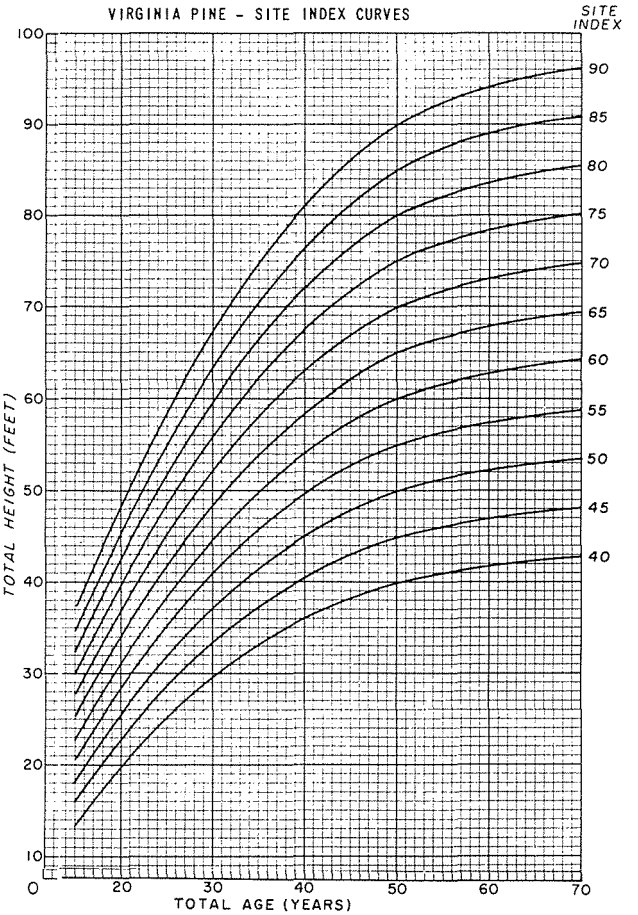
Height-growth classification for second-growth longleaf pine. Reproduced from USDA Forest Service Misc. Pub. No. 50.

Pond Pine



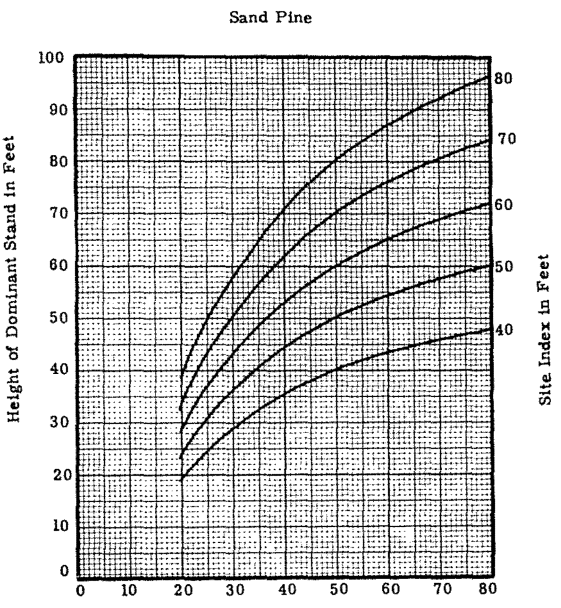
Pond pine: Height of dominant stand.

Reproduced from "Growth and Yields of Natural Stands of the Southern Pines" (1960) by F. X. Schumacher and T. S. Coile, by permission of the publisher T. S. Coile, Inc., Durham, North Carolina.



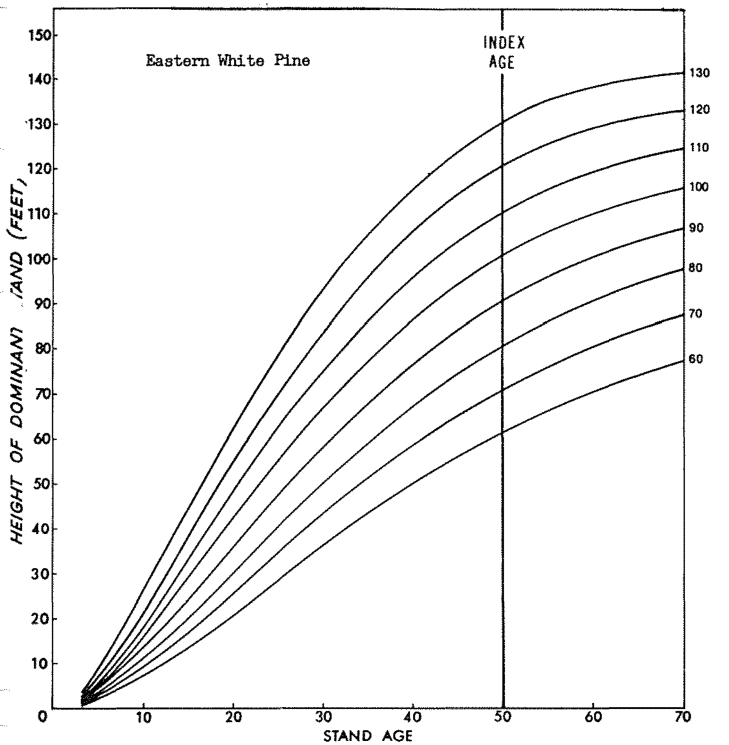
Site curves at an index age of 50 years for natural stands of Virginia pine in Maryland and the Piedmont of Virginia and the Carolinas. (Basis: 166 plots)

From: Research Note No. 135, S.E. Forest Experiment Station, Nov. 1959



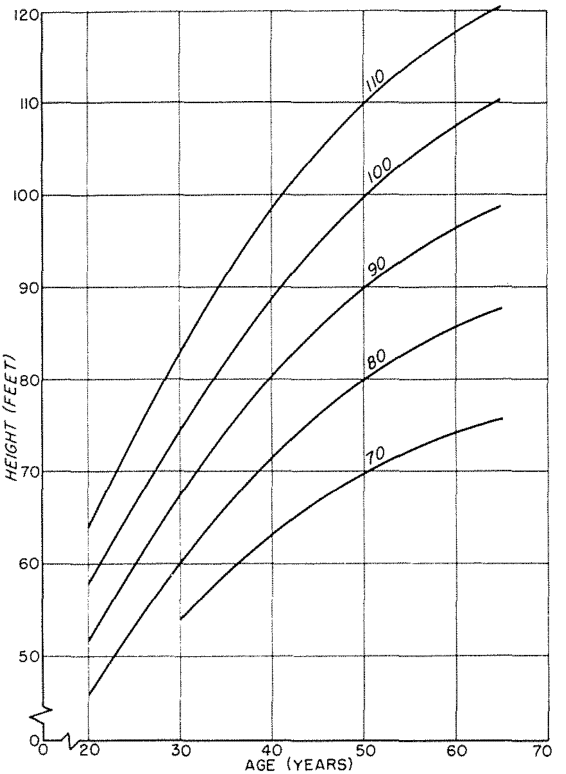
Sand pine: Height of dominant stand.

Reproduced from "Growth and Yields of Natural Stands of the Southern Pines" (1960) by F.X. Schumacher and T.S. Coile, Inc., Durham, North Carolina.

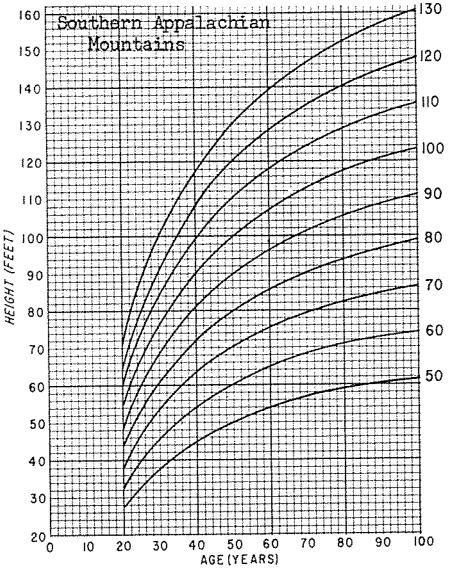


Polymorphic site index curves for natural stands of eastern white pine in the Southern Appalachians.

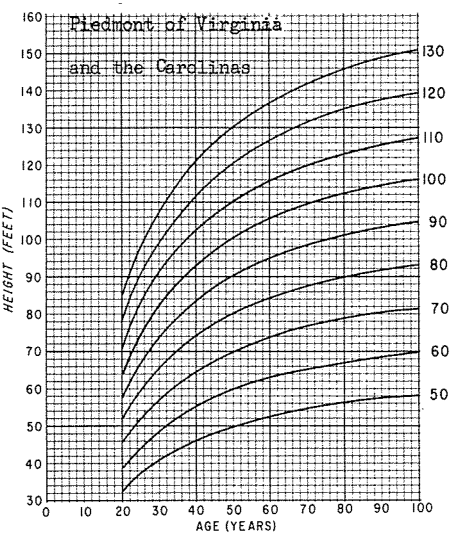
SWEET GUM

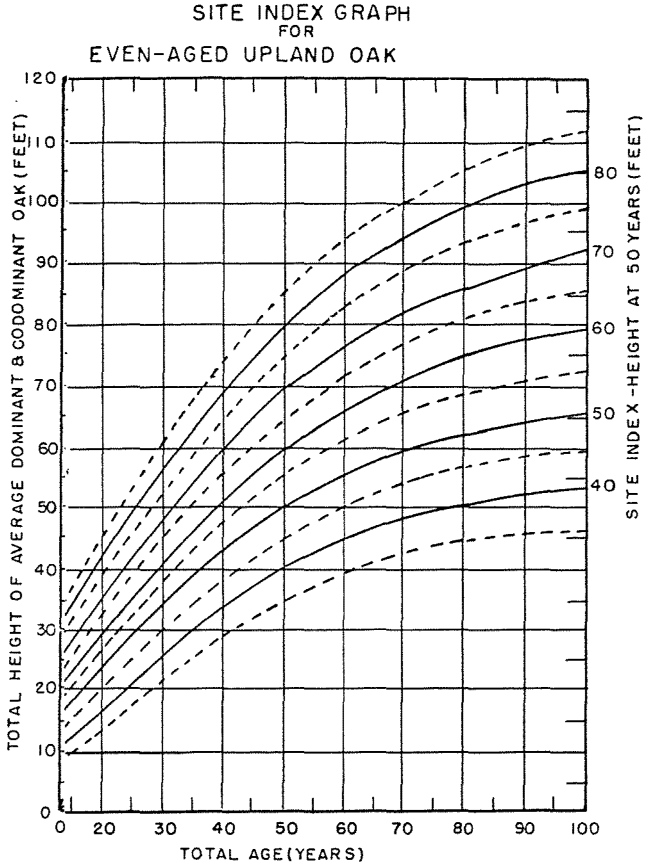


These curves indicate the expectable heights of sweetgum trees on sites of various quality To make such a check requires measurement that have had no modifying influence or treatment. For example, trees 80 feet tall at age 40 would signify a site index of 90.



Yellow poplar site index curves at an index age of 50-yrs.

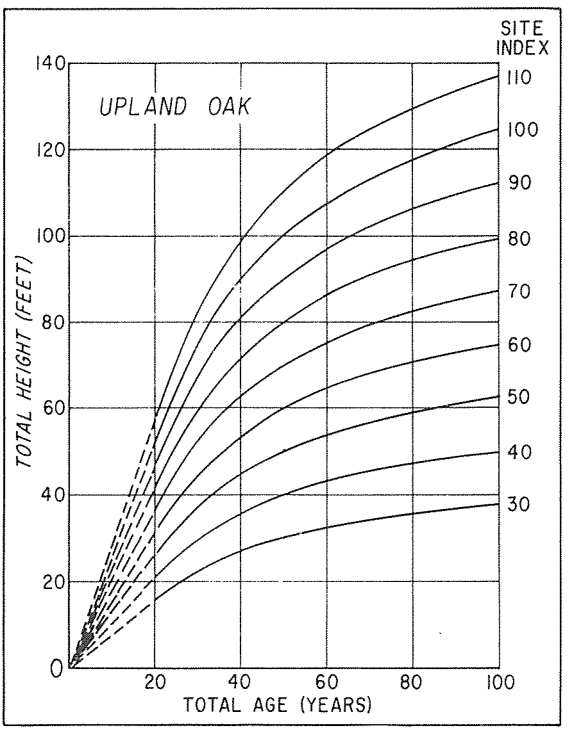




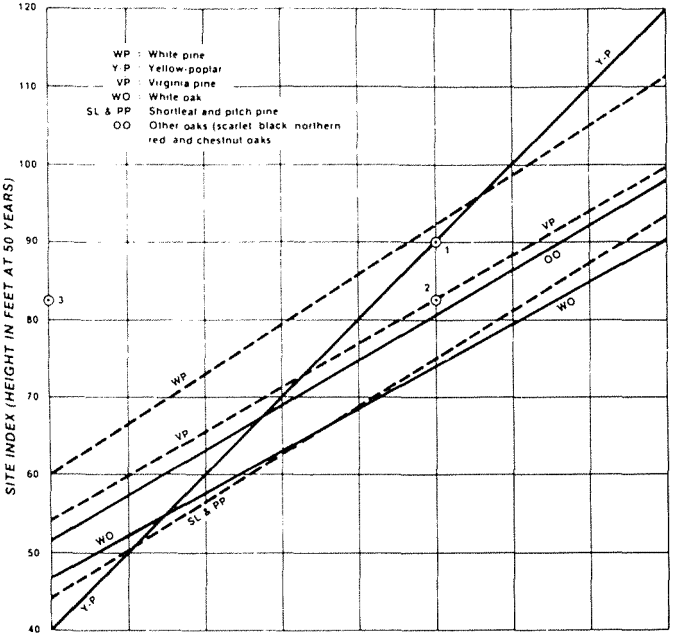
SOURCE: U.S.D.A. TECH. BUL. NO. 560 1937

SITE INDEX CURVES FOR UPLAND OAK IN THE SOUTHEAST

These site index curves are based on 697 observations of height on age for white, northern red, southern red, scarlet, black, and chestnut oak in the Virginia-Carolina Piedmont and the Southern Appalachian Mountains. The curves were constructed using equations of the form, Log Height = a + b $\left(\frac{1}{\text{Age}}\right)$.



Source: USDA Forest Service Research Note No. SE-125. April 1959.



A SITE INDEX COMPARISON GRAPH FOR 10 SPECIES ON THE SAME LAND IN THE SOUTHERN APPALACHIANS. (DOOLITTLE 1958)

REDCEDAR
Based on 271 observations from plots throughout the interior Valley, Summer 1948
TOTAL HEIGHT OF AVERAGE DOMINANT TREES (FEET)
TOTAL AGE (YEARS)
SITE INDEX - HEIGHT AT 50 YEARS (FEET)

A comparison of site indices, basal area, and volume at 50 years for 10 Southern Appalachian species on 3 sites (From Doolittle 1958)

Species	Site Index	Basal Area per acre	Volume per acre*		
	Feet	Sq.ft.	Cu.ft.	Cords	Bd.ft.
		Poor Site			
Shortleaf and pitch pine	50	159	3970	46.7	9,900
Yellow-poplar	50	90	1700	20.0	3,500
White oak	52	90	1726	20.3	3,860
Other oaks+	57	94	2041	24.0	5,385
Virginia pine	59	162	4180	49.2	20,000
White pine	66	190	5312	62.5	23,920
		Medium Site			
Shortleaf and pitch pine	65	166	5665	66.6	22,750
White oak	66	100	2590	30.5	8,370
Other oaks	72	103	2954	34.8	10,550
Virginia pine	74	180	5440	64.0	28,840
Yellow-poplar	75	132	3138	36.9	14,510
White pine	82	201	6976	82.1	35,964
		Good Site			
White oak	79	106	3388	39.9	13,350
Shortleaf and pitch pine	81	170	7487	88.1	36,465
Other oaks	86	108	3870	45.5	16,300
Virginia pine	88	188	6040	71.1	39,116
White pine	98	205	8256	97.1	45,328
Yellow-poplar	100	172	5330	62.7	32,150

*Conversion factor for cordwood was 85 cubic feet per cord.

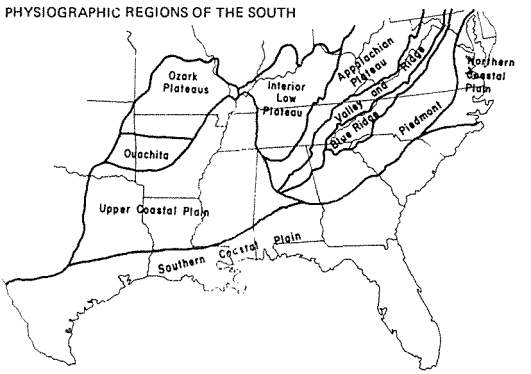
Board-foot volumes are international 1/8-inch rule.

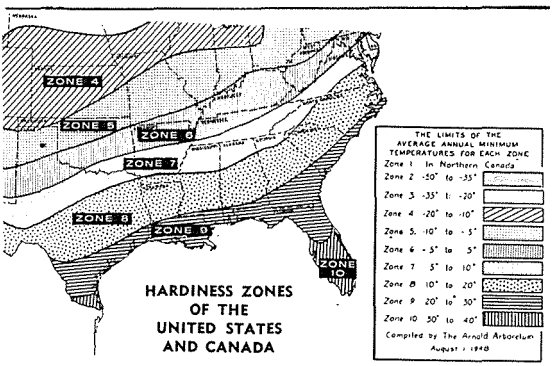
+Includes scarlet, black, northern red, and chestnut oaks.

LOBLOLLY PINE STOCKING CHART
WESTVACO CORPORATION
SUMMERVILLE, S. C.
1970
FOR APPLICATION THROUGHOUT LANDS
WHERE LOBLOLLY PINE IS GROWN
BASAL AREA PER ACRE
NUMBER OF TREES PER ACRE
POOR
MEDIUM
WELL
OVER
2"
3"
4"
5"
6"
7"
8"
9"
10"
11"
13"
15"
17"

What Trees to Plant Where

The first decision to make is what species to plant. This will depend to some extent upon what product the landowner wants to grow but, more importantly, it will depend upon the soil and location of the planting site. Remember, the biggest mistake made in tree planting to date is planting the wrong species. See the chart for general guidelines.




ZONE 1
ZONE 5
ZONE 6
ZONE 7
ZONE 8
ZONE 9
ZONE 10
HARDINESS ZONES OF THE UNITED STATES AND CANADA
THE LIMITS OF THE AVERAGE ANNUAL MINIMUM TEMPERATURES FOR EACH ZONE
Zone 1 In Northern Canada
Zone 2 -50° to -35°
Zone 3 -35° to -20°
Zone 4 -20° to -10°
Zone 5 -10° to -5°
Zone 6 -5° to 5°
Zone 7 5° to 10°
Zone 8 10° to 20°
Zone 9 20° to 30°
Zone 10 30° to 40°
Compiled by The Arnold Arboretum
August, 1948

Pine species-site planting guide

Physiographic Region	Poorly Drained Sites	Moderately Drained Sites	Dry Sites
Coastal Plain			
Northern	Loblolly	Loblolly	Virginia or Loblolly. Longleaf on sandhill sites only.
Southern	Slash or Loblolly	Slash or Loblolly	Longleaf. Choctawhatchee Sand in Fla., Ga. and S. Carolina
Upper	Loblolly	Loblolly	Shortleaf or Virginia
Piedmont			
Upper	Loblolly	Loblolly	Virginia or Shortleaf*
Lower	Loblolly	Loblolly	Loblolly or Shortleaf*
Blue Ridge		White Loblolly	Virginia or Shortleaf
Valley and Ridge		White	Virginia or Shortleaf
Appalachian		White	Virginia or Shortleaf
Interior Low Plateaus	Loblolly	Loblolly, Virginia & Shortleaf. White pine except in Alabama.	Virginia pine or Shortleaf
Ozarks		Loblolly (Ark. & Oklahoma)	Shortleaf
Ouachitas		Loblolly	Shortleaf

* Except where littleleaf disease is prevalent.

Geographic seed source

Species	For planting	Use seed from
Loblolly	Louisiana west of the Mississippi; southern Arkansas; eastern Texas; and southeastern Oklahoma.	Southeastern Texas
	Southeastern Louisiana; southern two-thirds of Alabama and Georgia, Southern two-thirds of Mississippi, and northwestern Florida.	Livingston Parish, Louisiana; and/or southwestern Mississippi
	Western Tennessee	Northern Mississippi, northern Alabama, and northern Georgia
	Central and eastern Tennessee; and western Kentucky	Maryland and Virginia
	Ozarks	Central Arkansas, northern Mississippi, and northern Alabama.
	North and South Carolina Coastal Plain	Coastal Plain of either state
	North and South Carolina Piedmont	Piedmont of either state
	Virginia; Maryland; and Delaware	Local sources preferred
	Northern Mississippi; northern Alabama; and northern Georgia	Northern Mississippi; northern Alabama; and northern Georgia

Geographic seed source (cont'd)

Species	For planting	Use seed from
Longleaf	Southern Mississippi; Alabama; western Florida; and 150 miles north and 250 to 300 miles east and west of Mobile, Alabama	Southern Mississippi; southern Alabama; and western Florida
	All other than above	Local sources only
Sand	Sand hills of northern Florida, Georgia, and South Carolina	Choctawhatchee variety
Shortleaf	Mississippi; central and southern sections of Alabama and Georgia; and southern South Carolina	Southern Mississippi, southern Alabama, southern Georgia, and northern Florida
	Northern Arkansas; northern Alabama; northern Georgia; northwestern South Carolina; central and western Tennessee; and central and northeastern North Carolina	Northern and central Mississippi, southern Arkansas, central Georgia, southern South Carolina, central Alabama, and southeastern North Carolina
	Missouri; eastern Kentucky, eastern Tennessee; eastern West Virginia; Virginia; and farther north	Local sources only
	Eastern Texas; western and northern Louisiana; southern Arkansas; and eastern Oklahoma	Eastern Texas, western and northern Louisiana, southern Arkansas, and eastern Oklahoma
Slash	North and west of the natural range	Natural stands in Mississippi, Louisiana, Alabama, South Carolina and southeastern Georgia

Geographic seed source (cont'd)

Species	For planting	Use seed from
Slash (Cont'd)	Anywhere within or near natural range	Natural stands anywhere north or west of Lake City, Florida or plantations of similar provenance
Virginia Pine	Within natural range	Local source preferred
White Pine (Eastern)	Appalachian areas of Georgia, Kentucky, North Carolina, Tennessee, and Virginia	Local or southern source

SHORTLEAF PINE THINNING GUIDE-Trees 4" D.B.H. & Over
LEAVE BASAL AREA (SQ. FT.) FOR SITE INDEX

AGE	40	50	60	70	80	90
20				58	70	80
25		55	69	82	88	91
30	55	72	85	92	93	95
35	68	83	92	94	96	97
40	77	89	93	95	97	98
45	82	90	93	95	97	98
50	84	91	93	96	97	99
60	86	91	94	96	97	99

LOBLOLLY PINE-THINNING GUIDE - TREES 4" D.B.H. & OVER
LEAVE BASAL AREA (SQ.FT.) FOR SITE INDEX

AGE	60	70	80	90	100	110
15					58	63
20		61	67	72	76	81
25	66	73	78	82	85	89
30	74	80	83	87	90	95
35	79	84	87	89	93	98
40	83	86	89	92	96	100
45	85	88	91	94	97	102
50	87	89	92	95	99	104
55	88	91	93	96	100	105
60	89	92	95	97	101	106

Leave tables are 57% of normal (Misc. Pub. 50).
Thin at 80% or over of B. A. of fully stocked stand.
To determine time for thinning - assume that the stand will approach normal at the rate of 4% per year, i.e. 68% Normal basal area - thin 3 years hence.

$$\left(\frac{80-68}{4} = 3 \right)$$

Virginia Division of Forestry

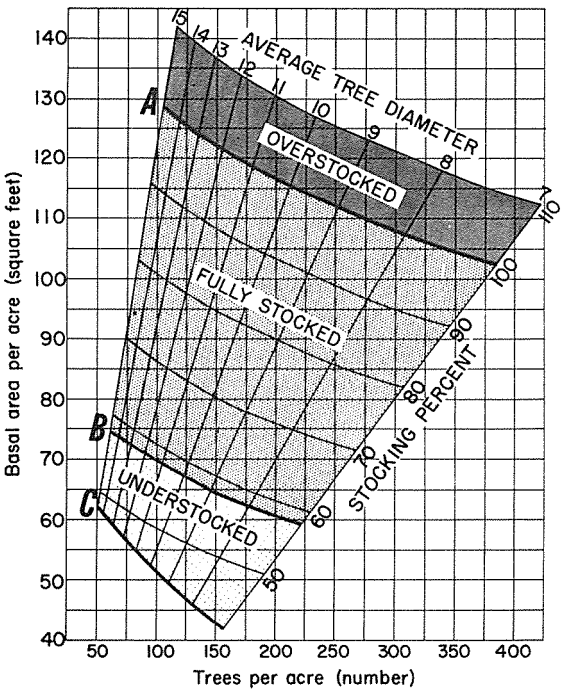
ACCOMPLISHMENTS AND ECOLOGICAL CONCERNS OF VARIOUS SITE PREPARATION PRACTICES USED IN THE COASTAL PLAIN.

Site Preparation Practice	Accomplishment				Major Ecological Concerns
	Debris	Competition	Soil Prep.	Microenv.	
Shearing		***1/	*	**	Compaction, erosion, soil displacement
Piling 2/	***	**	*	**	Compaction, erosion, soil displacement, nutrient drain, increased soil temperature
Burning	*	**		**	Air pollution, erosion, nutrient losses
Chemical		**		**	Water pollution
Chopping	**	*	*	**	Greater soil protection, retains nutrients, improves soil water, buffers soil temperature
Discing		***	***	***	Erosion, puddling, increased soil temperature, improved nutrients and water
Bedding		***	***	***	Erosion, improved nutrients, aeration, and water

1/ * Moderate effect, ** Large effect, *** Major effect
2/ Includes root-raking, windrowing, debris removal in front of planting machine.

Relation of basal area, number of trees, and average tree diameter to stocking percent for upland central hardwoods. Tree-diameter range 7-15 (left), 3-7 (right). The area between curves A and B indicates the range of stocking where

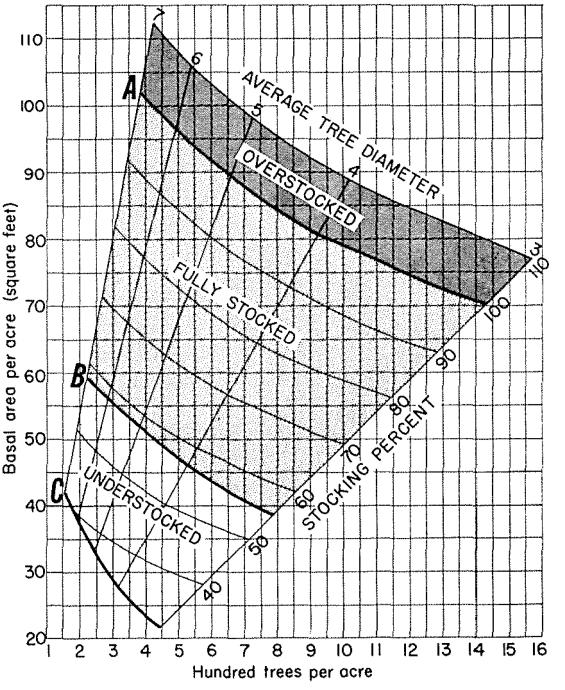
(continued on next page)



USDA, Forest Service Ag. handbook 355

(continued from previous page)

trees can fully utilize the site. Curve C shows the lower limit of stocking necessary to reach the B level in 10 years on average sites. (Average tree diameter is the diameter of the tree of average basal area.)



USDA, Forest Service Ag. handbook 355

PROCEDURE FOR USING HARDWOOD STOCKING CHARTS

--Use prism to determine basal area on 5 to 10 sample points (or more if conditions not uniform).

--At each sample point, count all trees 2 inches DBH and over - using 1/20th acre plot (26 1/3 ft. radius).

--Then, knowing the B.A. and the number trees per acre, read the "average tree diameter" and the "stocking percent" directly from the charts on the preceeding pages.

--Next, follow down the line of "Average Tree Diameter" (parallel to the nearest LOWER average diameter line) to line B; then follow the horizontal line from this point to find what the basal area should be for the stand (at intersection with B.A. axis).

EXAMPLE For a stand with B.A. of 90 and 220 trees per acre, the average DBH is about 8.7 inches and the stand is 81% stocked. The B-level B.A. is 65 and the C-level is 51.

If the B.A. of your stand exceeds C-level requirements, the stand is worth managing. If worth managing, deduct B-level B.A. from total B.A. to find the sq. ft. that may be cut (25 sq. ft. for this stand). Let stand grow up to 85-90% stocking, and thin again to near the B-level.

Foresters Field Handbook
North Carolina Forest Service
(Agriculture Handbook 355 Forest Service)

Species marking guide for bottomland hardwood stands			
Always favor	Desirable	Less Desirable	Always cut
Ash	*Willow oak	American elm (ordinary)	Bitter pecan
Sweetgum	*Water oak		Winged elm
			Rock elm
Yellow-poplar	*Nuttall oak	*Hackberry (ordinary)	Waterlocust
			Box elder
*Cherrybark oak	Cottonwood	Maple	Honeylocust
Cypress	Overcup oak	*Sweet pecan	Birch
Forked leaf white oak	(second growth)	*Blackgum	(ordinary)
		Overcup oak	Willow
Cow oak	*Persimmon	(over mature)	(ordinary)
Shumard oak	Sycamore	Birch (best	Hickory
Delta post oak	Tupelo	specimens)	(ordinary)
*Willow oak	American elm	Willow	
(in spots)	(best specimens)	(best specimens)	
*Water oak	*Hackberry	Hickory (best	
(in spots)	(best specimens)	specimens)	
		Mulberry	
*Important game food trees.			

Source: Timber Management guide for Yazoo-Little Tallahatchie Flood Prevention Project, USDA, Forest Service and Soil Conservation Service, cooperating with Soil Conservation Districts.

Relative Value and Tolerance to Competition of the Common Bottomland Hardwood Trees

Very Intolerant	Intolerant	Intermediate	Tolerant	Very Tolerant
		Highest Value		
Cottonwood	Cherrybark oak	Swamp chestnut oak		
	Shumard oak	White oak		
	White ash	Delta post oak		
	American sycamore	Green ash		
	Sweetgum	Baldcypress		
	Yellow-poplar	Pumpkin ash		
	Black walnut			
		Intermediate Value		
	Silver maple	Bur oak	Magnolia	Hackberry
	Nuttall oak	Southern red oak		Sugarberry
	Water oak	Pondcypress		
	Swamp tupelo	Laurel oak		
	Pecan			
	Kentucky coffeetree			
	Water tupelo			
		Low Value		
Willow	Willow oak	Post oak	American elm	Cedar elm
	Water hickory	Overcup oak	Winged elm	American beech
	River birch	Blackgum	Red maple	Hickory spp.
	Pin oak	Honeylocust		Red mulberry
	Swamp cottonwood	Waterlocust		
	Sweetbay	Persimmon		
		Weed Species		
	Sassafras	Planertree	Boxelder	American holly
		Buttonbush	Privet	American hornbeam
			Possumhaw	American hop-hornbeam
			Rough leaf dogwood	Hawthorn spp.

Source: Adapted from McDermott, 1954b; Putnam, 1951b; Hosner, 1957b; and Putnam et al. 1960.
Regional Silviculture of the United States; Edited by John W. Barrett; The Ronald Press Company, New York.

Relative Tolerance to Saturated Soil Conditions and Relative Value of the Common Bottomland Hardwood Trees

Very Intolerant	Intolerant	Intermediate	Tolerant	Very Tolerant
		Highest Value		
Cherrybark oak	American sycamore	Sweetgum	Green ash	Baldcypress
Shumard oak	Swamp chestnut oak	Cottonwood	Pumpkin ash	
White ash				
White oak				
Delta post oak				
Black oak				
Northern red oak				
Black walnut				
Yellow-poplar				
		Intermediate Value		
Southern red oak		Water oak	Bur oak	Pondcypress
		Silver maple	Laurel oak	Swamp tupelo
		Nuttall oak		Water tupelo
		Pecan		
		Hackberry		
		Sugarberry		
		Low Value		
	Winged elm	Cedar elm	Red maple	Black willow
	Hickory spp.	American elm	Willow oak	Swamp cottonwood
	Red mulberry	Pin oak	Waterlocust	
	Blackgum	Honeylocust	Overcup oak	
		River birch	Water hickory	
		Persimmon		
		Weed Species		
Sassafrass	Boxelder		Privet	Buttonbush
Hawthorn	American hornbeam		Possumhaw	Planertree
	American hophornbeam			Loblolly-bay
				Redbay

Source: Adapted from Briscoe, 1957; Green, 1947; Silker, 1948; Yeager, 1949; Hall and Smith, 1955; Demarce, 1932; McDermott, 1954a, and Hasner, 1959. Regional Silviculture of the United States.

SITE GUIDE FOR MOUNTAINS*

LANDSCAPE CHARACTERS			MANAGEMENT TYPE	
LANDFORM	MOISTURE REGIME	TEXTURE	PREFERRED	SUITABLE
COVES, ALLUVIAL FANS, STREAM TERRACES, FLOOD PLAINS	MOIST	MEDIUM	HARDWOODS YELLOW POPLAR, OAKS, WALNUT, SYCAMORE, W.ASH	—
	WET	FINE	HARDWOODS SWEETGUM, ASH BIRCH, W/W OAKS	—

LAND FORM	SOIL DEPTH 1/	MOISTURE REGIME	TEXTURE	PREFERRED	SUITABLE
RIDGES (20% SLOPE)	DEEP >30" TO BEDROCK OR HARDPAN	MOIST 5/	FINE TO MEDIUM	HARDWOODS OAKS, YELLOW POPLAR, ASH	PINE LOBLOLLY 2/ SHORTLEAF
		DRY 6/	COARSE	PINE SHORTLEAF WHITE	
	SHALLOW <30" TO BEDROCK OR HARDPAN	MOIST 5/	FINE TO MEDIUM	PINE SHORTLEAF WHITE 3/	PINE VIRGINIA
		DRY 5,6/	MEDIUM TO COARSE	PINE VIRGINIA	PINE WHITE
		DROUGHTY 5.6/	COARSE TO SKELETAL	PINE VIRGINIA	

LAND FORM	ASPECT	SOIL DEPTH 1/	SLOPE %	SLOPE POSITION 4/	TEXTURE	PREFERRED	SUITABLE
SIDE SLOPES	NORTH-ERLY	DEEP	ALL	ALL	ALL	HARDWOODS OAKS, YELLOW POPLAR, ASH, BASSWOOD, WALNUT	
		SHALLOW	ALL	U	ALL	PINE SHORTLEAF LOBLOLLY	PINE WHITE
				L	ALL	HARDWOODS YELLOW POPLAR, OAKS	PINE SHORTLEAF WHITE
	SOUTH-ERLY	DEEP	ALL	U	ALL	PINE SHORTLEAF WHITE	PINE VIRGINIA
				L	ALL	HARDWOODS-OAKS, YELLOW POPLAR, ASH	PINE WHITE
		SHALLOW	<50	ALL	ALL	PINE VIRGINIA	PINE SHORTLEAF LOBLOLLY 2/
			>50	ALL	LIMITED MANAGEMENT POSSIBILITIES		PINE VIRGINIA

*Footnotes 1-6 appear on the next page, with definitions of terms.

Footnotes for preceding tables:

1/ DEEP 30" SHALLOW <30"
2/ WINTER WEATHER RISK
3/ ESPECIALLY WHERE BARK BEETLES ARE A PROBLEM
4/ U - UPPER 1/2 L - LOWER 1/2
5/ BROAD RIDGES
6/ NARROW RIDGES

WET - Periods of excessive moisture due to periodic flooding, perched water tables (Pans), and poor dainage. Presence of mottled soils.

MOIST - Well drained soils, but with sufficient moisture to maximize tree growth throughout the year. Usually associated with loamy soils with some moisture retaining clays in the sub-soil.

DRY - Sites with insufficient moisture for maximum tree growth at least part of the year, due to excessive drainage and/or topographic position.

DROUGHTY - Excessively drained, usually very shallow, except for deep sands. Insufficient moisture for quality hardwood tree growth.

TEXTURE - The relative proportions of the various soil separates in a soil material.

Examples: broad definitions

Fine - Usually associated with clay textured soils.
Medium - Usually associated with loamy textured soils.
Coarse - Usually associated with sandy textured soils.
Skeletal- A soil with more than 35% by volume of gravelly (< 3" diameter) or cobbly (3-10" diameter) material.

SITE GUIDE FOR PIEDMONT AND CUMBERLAND PLATEAU

LANDSCAPE CHARACTERS		MANAGEMENT TYPE	
	Moisture Regime	Texture	PREFERRED
FLOOD PLAINS, STREAM TERRACES, FANS, COVES	WET	Fine	SWEETGUM, W/W OAK/ASH
	MOIST	Medium	OAKS, YELLOW POPLAR, HICKORIES, SYCAMORE

LANDSCAPE CHARACTERS				MANAGEMENT TYPE [2]	
LANDFORM	PAST EROSION	MOISTURE REGIME	TEXTURE	PREFERRED	SUITABLE
RIDGE TOPS	SLIGHT	WET [3]	Fine to Medium	HARDWOODS SWEETGUM, W/W OAK	PINE LOBLOLLY
		MOIST [3]	Medium	PINE LOBLOLLY	PINE SHORTLEAF
		DRY [4]	Coarse	PINE LOBLOLLY	PINE VIRGINIA
	SEVERE	MOIST [3]	Medium	PINE LOBLOLLY	PINE VIRGINIA
		DRY & DROUGHTY [3,4]	Coarse to skeletal	PINE VIRGINIA	PINE LOBLOLLY

LANDSCAPE CHARACTERS					MANAGEMENT TYPE	
LANDFORM	ASPECT	SLOPE POS.	PAST EROSION	TEXTURE	PREFERRED	SUITABLE
SIDESLOPES (MANAGEABLE AREAS EXCEEDING 15-20% SLOPE)	NORTHERLY	UPPER	SLIGHT	ALL	PINE LOBLOLLY	PINE SHORTLEAF
			SEVERE	ALL	PINE LOBLOLLY	PINE VIRGINIA
		LOWER	SLIGHT	FINE TO MEDIUM	HARDWOODS OAKS, YELLOW POPLAR, ASH, HICKORIES	LOBLOLLY
			SEVERE	COARSE	HARD-WOODS/ PINE LOBLOLLY	
	SOUTHERLY	UPPER	SLIGHT	ALL	PINE LOBLOLLY	PINE VIRGINIA SHORTLEAF
			SEVERE	ALL	PINE VIRGINIA	PINE LOBLOLLY
		LOWER	SLIGHT	FINE TO MEDIUM	PINE SHORTLEAF LOBLOLLY	PINE
			SEVERE	COARSE	PINE LOBLOLLY	PINE VIRGINIA

1/ W/W OAK - WATER/WILLOW OAK

2/ WHITE PINE COULD ALSO BE SUITABLE FOR RIDGES AND SIDE SLOPES OF AREAS OF THE CUMBERLAND PLATEAU

3/ BROAD RIDGES

4/ NARROW RIDGES

SITE GUIDE FOR COASTAL PLAIN

LANDSCAPE CHARACTERS			MANAGEMENT TYPE	
	MOISTURE REGIME	SOIL TEXTURE	PREFERRED	SUITABLE
FLOOD PLAINS, STREAM TERRACES, AND ALLUVIAL FANS.	WET	FINE	HARDWOODS, ASH, GUM, W/W OAKS, & CYPRESS	
	MOIST	FINE TO MEDIUM	OAKS, CHERRY BARK, NUTTALL, SHUMARD, ETC. COTTONWOOD, ASH, SYCAMORE	

LANDSCAPE CHARACTERS			MANAGEMENT TYPE	
LANDFORM	MOISTURE REGIME	DOMINANT SOIL TEXTURE	PREFERRED	SUITABLE
UPLANDS (MOSTLY RIDGES)	WET	ALL	HARDWOODS W/W OAKS, GUM	PINE LOBLOLLY, SLASH
	MOIST	FINE TO MEDIUM	HARDWOOD PINE	
		FINE	PINE LOBLOLLY, SLASH	PINE SHORTLEAF
	DRY	ALL INC. COARSE, GRAVELLY & COBBLY	PINE LONGLEAF, SHORT-LEAF, SAND	PINE LOBLOLLY
	SEVERELY ERODED		PINE LOBLOLLY	-

FEATURES OFTEN CORRELATED WITH SITE INDEX

Soil Features:

1. Surface soil depth, depth to mottling, depth to impermeable layer, effective soil depth.
2. Texture and stone content.
3. Structure and drainage, subsoil color, and mottling.

Topographic Features:

1. Aspect, slope position, slope steepness, slope shape.
2. Elevation, latitude.

Climatic Features:

1. Annual rainfall, growing season rainfall, temperature.

DICHOTOMOUS KEY FOR FIELD IDENTIFICATION OF SOIL TEXTURE

A.
Soil, when pinched between the thumb and finger, crumbles, will form no 'ribbon.'

B. Soil, squeezed in hand when dry, falls apart readily: squeezed when moist, forms a cast that breaks if not handled very carefully. Individual sand grains can be readily seen and felt.....sandy loam.

B. Soil, queezed in hand when dry, forms cast that bears careful handling; squeezed when moist. Forms a cast that can be handled quite freely without breaking. Soil smooth. Sand grains not readily evident.

C. Soil slightly plastic when moist, but not greasy. Gritty when dry, not floury. Color brown or dark gray.....loam.

C. Soil greasy when moist, floury when dry. On wetting it runs together and puddles. Color light gray to nearly white.....silt loam.

A.
Soil, when pinched between the thumb and finger, forms a 'ribbon' at least barely sustaining its own weight.

D. Ribbon breaks easily, barely sustains own weight.

E. Individual sand grains can readily be seen and felt. Moist soil friable. Color usually brownish yellow to brownish red.....sandy clay loam.

E. Soil smooth. Sand grains not evident. Moist soil somewhat plastic.

F. Soil heavy and greasy when moist. Color dull gray, sometimes containing iron concentrations... Silty clay loam.

F. Soil mellow and loose when moist. Color usually yellowish brown to reddish brown....clay loam.

D. Ribbon is long and flexible, strong.

G. Individual sand grains can readily be seen and felt. Moist soil somewhat friable. Color usually bright red or yellow.....sandy clay.

G. Sand not evident. Moist soil plastic.

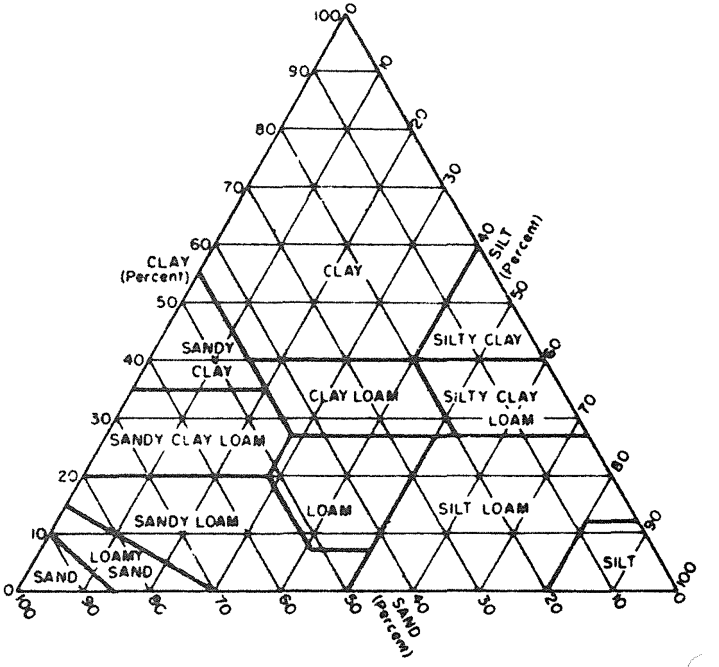
H. Color usually gray, sometimes containing iron concretions.....silty clay.

H. Color usually dark red, often mottled with gray or yellow.....clay.

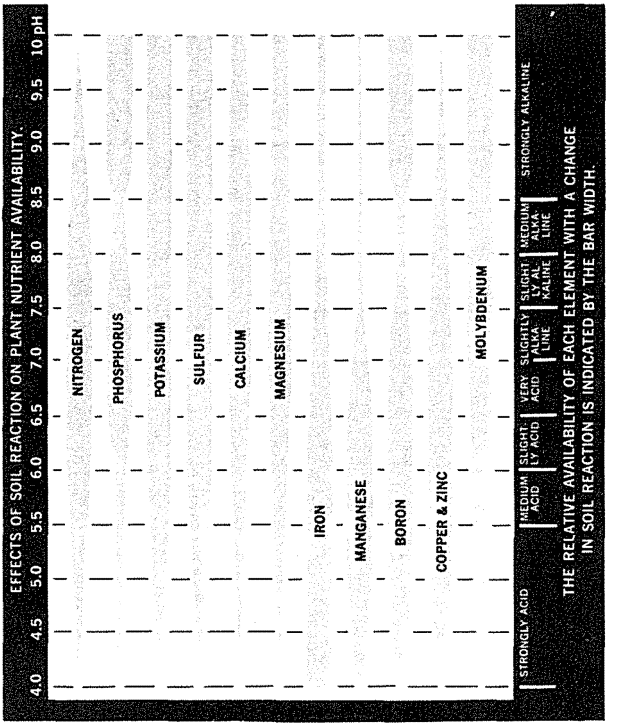
TEXTURE CLASSIFICATION OF SOILS

Soil texture refers to the relative proportions of sand, silt, and clay particles which make up the soil mass. Figure 6 shows the percentages of these soil fractions in the basic textural grades; definitions and discussion of this subject may be found in the Soil Survey Manual (Agriculture Handbook 18, U. S. Department of Agriculture, 503 pp., 1951).

Soil texture can be found exactly in a laboratory analysis. It can also be adequately classified in the field, after some experience, by sight and feel. On the opposite page is a key to the important textural grades. The first three--sandy loam, loam, and silt loam--are common surface soils, and may occur as subsoils. The rest are subsoils.



EFFECTS OF SOIL REACTION ON PLANT NUTRIENT AVAILABILITY.



SOIL SUITABILITY TABLE

Species	Best Suited	Least Suited	Limiting Factors
Cottonwood	Adler, Catalpa, Collins, Commerce, Coushatta, Falaya, Kaufman, Latanier, Marietta, Morganfield	Atwood, Calloway, Dulac, Henry, Kalmia, Lax, Leaf, Stough, Mashulaville, Tippo	Low moisture, Low nutrients, Poor aeration
American sycamore	Adler, Collins, Commerce, Dubbs, Latanier, Marietta, Morganfield, Robinsonville, Ochlockonee, Vicksburg	Atwood, Henry, Izagora, Lax, Leaf, Prentiss, Mashulaville, Stough, Tippo	Low fertility, Poor aeration
Yellow-poplar	Chewacla, Collins, Falaya, Iuka, Marietta, Ochlockonee, Vicksburg	Alligator, Buxin, Catalpa, Perry, Jackport, Tuscumbia	Excessive wetness, Poor aeration, High pH.
Sweetgum	Adler, Arkabutla, Collins, Chewacla, Commerce, Dundee, Marietta, Morganfield, Urbo	Bibb, Buxin, Henry, Leaf, Mashulaville, Perry, Stough, Tippo, Tuscumbia	Low moisture Poor aeration
Green ash	Adler, Arkabutla, Catalpa, Collins, Commerce, Falaya, Marietta, Mhoon, Waverly, Wehadkee	Atwood, Bude, Cahaba, Crevasse, Henry, Kalmia, Lax, Mashulaville, Prentiss, Stough	Low moisture
Water tupelo	Alligator, Bibb, Johnston, Una, Waverly, Wehadkee	Atwood, Crevasse, Henry, Lax, Stough, Mashulaville	Low moisture Alkaline soil
Nuttall oak	Arkabutla, Bowdre, Chewacla, Falaya, Houlka, Iuka, Mantachie, Newellton, Urbo	Atwood, Catalpa, Crevasse, Falkner, Kalmia, Lexington, Stough, Mashulaville, Tippo, Trinity	High pH, Low moisture
Shumard oak	Bruno, Bosket, Collins, Dubbs, Memphis, Vicksburg	Catalpa, Henry, Johnston, Perry, Roebuck, Tuscumbia	High pH, Poor aeration
Cherrybark oak	Arkabutla, Chewacla, Collins, Dundee, Falaya, Houlka, Iuka, Ochlockonee, Urbo, Vicksburg	Baldwin, Catalpa, Commerce, Crevasse, Johnston, Mhoon, Moreland, Portland, Trinity, Tuscumbia	Low moisture, Poor aeration, High pH.
Willow oak	Amagon, Collins, Arkabutla, Dundee, Houlka, Urbo	Atwood, Catalpa, Crevasse, Lax, Johnston, Stough	High pH, Low moisture Poor aeration
Swamp chestnut oak	Arkabutla, Chewacla, Collins, Forestdale, Urbo	Atwood, Catapla, Crevasse, Lax, Mashulaville	High pH, Low moisture
Water oak	Amagon, Bowdre, Chewacla, Collins, Falaya, Urbo	Atwood, Catalpa, Crevasse, Stough, Tippo	Low moisture, High pH.
White oak	Chewacla, Collins, Dundee, Gallion, Iuka, Memphis, Vicksburg	Buxin, Catalpa, Iberia, Mhoon, Johnston, Tuscumbia	High pH, Excessive moisture, Poor aeration

General Management Interpretations for Broad Soil/land forms Within the Southeastern Area

Physiographic Regions	Wet	Moist	Dry	Aeration	Nutrients	Competition	Productivity	Accessibility
I. Coastal Plains Soils								
a. Swamps	X			Low	Variable	Low	Low	Poor
b. Landlocked Bays	X			Low	Variable	Severe	Mod-High	Poor
c. Floodplains	X	X		Low-Mod	Mod-High	Severe	High	Poor-Fair
d. Terraces		X		Mod	Mod-High	Mod-Sev	High	Fair-Good
e. Upland Flats	X	X		Low-Mod	Mod	Mod-Sev	Mod-High	Good-Fair
f. Sandhills			X	High	Low-Mod	Low-Mod	Low-Mod	Good
g. Flatwood	X			Low-Mod	Low	Mod-Sev	Low-Mod	Fair-Poor
II. Piedmont Soils								
a. Narrow Ridgetops			X	High	Low-Mod	Low	Low	Good
b. Steep Side Slopes (Aspect dependent)		X	X	Mod-High	Low-High	Low-Severe	Low-High	Poor
c. Broad Upland Flats	X	X		Low-Mod	Mod	Mod-Sev	Mod-High	Good-Fair
d. Stream Terraces		X		Mod	Variable	Mod-Severe	High	Fair-Good
e. Floodplains	X	X		Low-Mod	High	Severe	High	Poor-Fair
III. Mountain Soils [1/]								
a. Narrow ridge tops			X	High	Low-Mod	Low	Low	Good
b. Steep Side Slopes (Aspect dependent)		X	X	Mod-High	Low-Variable	Low-Severe	Low-High	Poor
c. Broad upland Flats	X	X		Low-Mod		Mod-Severe	Mod-High	Good-Fair
d. Stream Terraces		X		Mod	Variable	Mod-Severe	High	Fair-Good
e. Narrow Valley Bottoms	X	X		Low-Mod	Variable	Severe	High	Poor
f. Alluvial Fans	X	X		Low-Mod	Variable	Severe	High	Fair-Good

1/ 1. Blue Ridge, 2. Ridge and Valley, 3. Appalachian, 4. Ozarks, 5. Ouachitas.

SOIL/SITE RELATIONS FOR BLACK OAK

Slope Position and Percent of Distance From Ridge to Bottom	ASPECT [1]	Slope Shape CONVEX	LINEAR	CONCAVE
Upper Slopes and Ridges (0 to 25)	NE	68	73	79
	SE and NW	65	70	75
	SW	62	66	71
Upper Mid-slopes (26 to 50)	NE	70	76	81
	SE and NW	67	72	77
	SW	64	69	74
Lower Mid-slopes (51 to 75)	NE	73	78	84
	SE and NW	69	74	80
	SW	66	71	77
Lower Slopes and Bottoms (76 to 100)	NE	75	81	87
	SE and NW	72	77	83
	SW	68	74	79

Predicted site index for black oak growing on fine textured upland soils having restricted internal drainage (Rarden, Coolville, Keene, Upshur, and Lathem Soil Series) (Carmean 1967).

[1] Northeast aspects are from 337° to 113°, southeast from 114° to 155°, southwest from 156° to 295°, and northwest from 296° to 336° azimuth.

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EROSION CONTROL LIMITS

To maintain or improve soil productivity, erosion must be kept within acceptable limits. 1/

Percent Slope	Minimum Percent Ground Cover Needed
0	0
5	10
10	40
15	60
20	70
25	75
30	80

1/ This table was constructed using the Universal Soil Loss Equation and the southeastern Area, Erosion Data Bank. The goal is to keep erosion to approximately 12 tons/acre total for the recovery period of the disturbance.

SOIL SITE INDEX TABLE

	SUBSOIL	SPECIES	DEPTH TO SUBSOIL IN INCHES						
			2	4	6	8	10	12	18
			SITE INDEX						
1.	Very friable	LLP	57	79	82	86	88	89	91
		SLP	51	62	66	68	69	70	71
2.	Friable	LLP	52	74	77	81	83	84	86
		SLP	47	59	62	64	65	66	67
3.	Semi-plastic	LLP	46	68	71	75	76	77	79
		SLP	43	54	58	60	61	62	63
4.	Plastic	LLP	38	60	63	68	69	70	72
		SLP	38	49	53	55	56	57	58
5.	Very Plastic	LLP	32	54	57	61	62	64	66
		SLP	33	44	48	50	51	52	53

LLP - Loblolly pine
SLP - Shortleaf pine
Virginia Division of Forestry

FACTORS

1 acre-foot = 43,560 cu. ft. = 325, 825 gals.
1 cu. ft. = 7.48 gals = 62.427 lbs.
1 U. S. gallon = 0.1337 cu. ft. = 8.330 lbs.
1-1/2 cu. ft./sec. = approx. 1,000,000 gals/day.
Average rainfall for U.S. = 30"/yr.
Evapo-transpiration is approx. 2/3 annual rainfall.

RECOMMENDATIONS FOR LOG ROADS AND SKID TRAILS 1/

1. Keep grades below 10% (20% for short distances).
2. Grades of 3 to 5% are desirable.
3. Avoid locating on 60% or greater slopes.
4. Avoid rock out-cropping and swampy places.
5. Stay out of stream beds (see filter strip table).
6. Cross streams at right angles.
7. Slope stream approach toward stream.
8. Drain as necessary according to slope - see tables.
9. Use rocks, logs, brush at lower end of water bar to break force.

RECOMMEND DISTANCES BETWEEN WATER BARS ON RETIRED SKID ROADS 1/

Road Grade %	Distance	Road Grade %	Distance
2	250'	20	45'
5	135'	25	40'
10	80'	30	35'
15	60'	40	30'

Lay out water bars at 45° to 60° angle from road center line, and at least 18" deep.

1/ Check with State Forester's office Best Management Practices (BMP's) developed in the State Water Quality Management Plan for Forestry. If BMPs are not available, use this information as a guide.

Size requirements for stream crossing structures based on Drainage area above crossing and 10-year storm. 1/

Size Required Culvert Dia (in)	Area (ft^2)	Area Above Crossing Acres
18	1.76	7 or less
21	2.40	12
24	3.14	16
30	4.90	27
36	7.06	47
42	9.62	64
48	12.56	90
54	15.90	120
60	19.63	160
66	23.75	205
72	28.75	250
78	33.18	350

I. Management Practices to Reduce I & D Damage

A. Annosus root rot of pines

1. Is most likely to kill trees in sandy or sandy loam soils 12" or more in depth. Trees infected, but not killed, may be weakened sufficiently to attract bark beetle and/or suffer excessive windthrow. Prevent infection by:

(a) Sprinkling a light coat of granular borax on the freshly-cut stumps following a partial cut.

(b) In the deep South, scheduling cutting operations from May through September (July and August in coastal Virginia).

(c) Minimizing number of thinnings during rotation.

B. Reproduction Weevils (Hylobius pales & Pachylobius picivorus)

Adult weevils occasionally kill as many as 90% of newly planted pine seedlings, mainly during the early spring the first year after planting on recently harvested or site prepared sites which supported pine.
Control: delay planting of cut-over woodland one full growing season where more than one (1) cord per acre of pine stumpage is removed or disturbed in site preparation or treat seedlings with an insecticide registered for that purpose.

C. Fusiform Rust

This fungus can cause extensive loss to young loblolly, slash, pitch and pond pine. Surveys indicate that Georgia, Alabama, Mississippi, Louisiana, South Carolina, North Carolina and Florida are the SE States with the most acreage susceptible to damaging infection. A regional hazard-rating map has been developed. Certain high-hazard areas should be planted with rust resistant species or resistant varieties of slash or loblolly. Incidence and severity is governed by such factors as the abundance of spore inoculum, humidity and rainfall, abundance of alternate hosts (oaks) and relative susceptibility of pine host. Guidelines are available for site examination and for intermediate cuts in infected stands.

D. White Pine Blister Rust

Essentially a localized problem in Virginia and North Carolina in the higher elevation (over 2500'). Where E white pine is to be planted in known hazard areas, sites should be examined for the alternate host (Ribes sp.) before final species choice is made. Protection involves eradication of all Ribes bushes within 300' of the young pines.

II. Other Pests of Importance

A. Gypsy Moth

Presence of male moths (and possible infestations) can be assessed by use of pheromone traps. Defoliation, the presence of larvae, pupae or egg masses can be indicators of gypsy moth presence. Isolated infestations should be reported to the USDA who would apply measures to prevent further spread or eliminate the infestation. Losses to mixed oak forests in the southern Appalachians is expected to be significant once the gypsy moth is established there.

Resistance of Species to Hurricane-Related Damages
(In Descending Order of Resistance)

Breakage	Uprooting	Salt	Deterioration by Insects and Disease
Live oak	Live oak	Live oak	Live oak
Palm	Palm	Palm	Palm
Bald cypress	Bald cypress	Slash pine	Sweetgum
Pond cypress	Pond cypress	Longleaf pine	Water oak
Sweetgum	Tupelo gum	Pond cypress	Sycamore
Tupelo gum	Red cedar	Loblolly pine	Bald cypress
Mimosa	Sweetgum	Red cedar	Pond cypress
Dogwood	Sycamore	Tupelo gum	Southern red oak
Magnolia	Longleaf pine	Bald cypress	Magnolia
Sweet bay	Mimosa	Sweetgum	Tupelo gum
Southern red oak	Southern red oak	Water oak	Sweet bay
Water oak	Magnolia	Sycamore	Hickory
Sycamore	Slash pine	Sweet bay	Pecan
Longleaf pine	Loblolly pine	Southern red oak	Red cedar
Slash pine	Sweet bay	Hickory	Red maple
Loblolly pine	Water oak	Mimosa	Mimosa
Red cedar	Red maple	Pecan	Dogwood
Hickory	Dogwood	Magnolia	Longleaf pine
Red maple	Hickory	Red maple	Slash pine
Pecan	Pecan	Dogwood	Loblolly pine

SILVICULTURAL CONSIDERATIONS FOR SOUTHERN PINE BEETLE CONTROL STRATEGIES

Timely and properly applied silviculture is the most effective and economical control available for southern pine beetle. This fact should be considered in all forest mangement prescriptions and decisions. Knowing which stands are the most likely candidates (or least likely) for SPB attack is important. Several geographically specific stand hazard rating systems for SPB have been developed. Check with your State Forester for one applicable for your area. A more generalized description of high risk stands and silvicultural recommendations are presented below.

		Southern Coastal Plain	Piedmont	Southern Appalachians
Charateristics of Susceptible stands		Densely stocked stands Large proportion of sawtimber Declining radial growth Poorly drained soils and low-lying areas High percentage of shortleaf and /or loblolly pine in the stand	Well stocked stands Small sawtimber Slow radial growth during last 10 years High percentage of clay in surface and subsurface soils High percentage of shortleaf pine	Densely stocked natural stands Large proportion of over-mature sawtimber Slow radial growth Dry, south-facing slopes High percentage of shortleaf and/or pitch pine
Species Susceptibility	Least Resistant	Shortleaf Loblolly	Shortleaf	Shortleaf Pitch
	Most Resistant	Slash Longleaf	Virginia Loblolly	Virginia Eastern White
Silvicultural Practices (all regions)		Maintain proper stand density at a range of 80-100 ft.^{2} basal area per acre Regulate age classes by eliminating over-mature stands and avoiding large unbroken stands of the same age and species Favor most resistant species after considering specific site and disease relationships Minimize logging damage Manage species composition by encouraging hardwood on hardwood sites Remove high hazard trees damaged by lightning wind, ice, disease, or other insects or logging		

Developed from Agriculture Handbook 576

Herbicide or Pesticide Mixing Formulas

The following formulas may be helpful when mixing herbicides or pesticides:

1. The percent of active ingredient in a spray mixture:

$$\frac{\text{lbs. of "cide" used} \times \text{\% active ingredient in "cide"}}{\text{gals. of spray mixture} \times \text{wt. 1 gal. diluent}}$$

2. The pounds of wettable powder needed to mix a spray containing a given percentage of active ingredient:

$$\frac{\text{gals. of spray wanted} \times \text{\% active ingredient wanted} \times \text{wt. 1 gal. diluent}}{\text{\% active ingredient in "cide" wettable powder used}}$$

3. The gallons of concentrate needed to mix a spray containing a given percentage of active ingredient:

$$\frac{\text{gals. of spray wanted} \times \text{\% of active ingredient wanted} \times \text{wt. 1 gal. diluent}}{\text{lbs. active ingredient per gallon in "cide" concentration used} \times 100}$$

4. The pounds of concentrate to use to prepare a solution or suspension on a weight-to-weight basis:

$$\frac{\text{\% active ingredient in finished spray} \times \text{amount in gals. of finished spray} \times \text{weight of 1 gal. diluent}}{\text{\% active ingredient of concentrate}}$$

CONVERSION FACTORS

Some conversion factors of importance in herbicide or pesticide mixing are:

Measures

1 tablespoonful	= 3 teaspoonfuls
2 tablespoonfuls	= 1 fluid ounce
16 "	= 1 cup
8 fluid ounces	= 1 cup
2 cups	= 1 pint
16 fluid ounces	= 1 pint
16 cups	= 1 gallon
128 fluid ounces	= 1 gallon
3785.3 ccs.	= 1 gallon

Weights

1 gallon of pure water weighs 8.345 lbs.

1 gallon of Diesel oil weighs 7.0 lbs.

454 grams = 1 pound

1 ounce per square foot = approx. 2722.5 lb/acre

1 ounce per square yard = approx. 302.5 lb/acre

1 lb. per 100 square feet = 435.6 lb/acre

1 pint per square rod = 20 gal. per acre

1 gram per square feet = approx. 96 lb/acre

Dilution Table for Preparing Spray and Dust Mixtures

Pesticide Formulation	Amount of formulation needed per acre to obtain the following amounts of active chemical per acre				
	1/8 lb	1/4 lb	1/2 lb	3/4 lb	1 lb
1% dust	12 1/2 lbs	25 lbs	50 lbs	75 lbs	100 lbs
5% dust	2 1/2 "	5 "	10 "	15 "	20 "
10% dust	1 1/4 "	2 1/2 "	5 "	7 1/2"	10 "
25% wettable powder	1/2 "	1 "	2 "	3 "	4 "
40% wettable powder	1/3 "	2/3 "	1 1/4 "	7/8"	2 1/2"
50% wettable powder	1/4 "	1/2"	1 "	1 1/2"	2 "
75% wettable powder	1/6 "	1/3"	2/3"	1 "	1 1/3"
10-12% emulsion 1 lb active ingredients/gallon	1 pt	1 qt	2 qt	3 qt	1 gal
15-20% emulsion concentrate 1 1/2 lb active ingredients/gallon	1/3 qt	2/3"	1 1/3 "	2 "	2 2/3qt
25% emulsion concentrate 2 lb active ingredients/gallon	1/2 pt	1 pt	1 "	3 pt.	2 qt
40-50% emulsion concentrate 4 lb active ingredients/gallon	1/4 "	1/2 "	1 pt	1 1/2"	1 "
60-65% emulsion concentrate 6 lb. active ingredients/gallon	1/6 "	1/3 "	2/3 "	1 "	1 1/3pt
70-75% emulsion concentrate 8 lb. active ingredients/gallon	1/8 pt	1/4 pt	1/2 pt	3/4 pt	1 pt

Rate	1 gallon of mix covers:			
	Feet of rows and spacing between rows			
Gallons per acre	Square feet	3 feet	3 1/2 feet	4 feet	4 1/2 feet
5	8,712	2,904	2,489	2,178	1,714
10	4,356	1,452	1,245	1,089	857
50	871	290	266	218	171
75	581	194	249	145	114
100	436	145	125	109	86

DILUTION OF PESTICIDES

Percent	Dilution	P/M	Grams/Liter
1.0	1:100	10,000	10.0
0.1	1:1,000	1,000	1.0
0.01	1:10,000	100	0.1
0.001	1:100,000	10	0.01
0.0001	1:1,000,000	1	0.001

1 Part/Million (P/M):

By weight: 1 miligram per kilogram
By volume: 1 microliter per liter
One ounce in 7,500 gallons, or 1 lb in 120,000 gallons is approximately 1 part per million by weight in water.

Dilution of Liquid Pesticides

Amount of Mix	Amount of spray material to use for these dilutions			
	1:200	1:400	1:600	1:800
1 quart	1 tsp.	1/2 tsp.	1/3 tsp.	1/4 tsp.
1 gallon	4 tsp.	2 tsp.	1 1/2 tsp.	1 tsp.
5 gallons	3 1/4 oz.	1 2/3 oz.	1 oz.	4/5 oz.
50 gallons	1 quart	1 pint	2/4 pint or 12 oz.	1/2 pint or 8 oz.

Amount of Herbicide for Different Concentrations

When acid equivalent of herbicide is	...and the required concentration of mix in lbs. of acid/100 gallons is:						
	2	4	6	8	12	16	20
2.00 Lbs/Gal.	1.0	2.0	3.0	4.0	6.0	8.0	10.0
3.00 Lbs/Gal.	.7	1.3	2.0	2.7	4.0	5.3	6.7
3.34 Lbs/Gal.	.6	1.2	1.8	2.4	3.6	4.8	6.0
4.00 Lbs/Gal.	.5	1.0	1.5	2.0	3.0	4.0	5.0
6.00 Lbs/Gal.	.3	.7	1.0	1.3	2.0	2.7	3.3

CHECKLIST FOR MULTIPLE USE FOREST LAND MANAGEMENT PLANNING

POTENTIALS FOR SERVICE FORESTER CONSIDERATION

Timber Production

Site Quality
Tree Quality
Species
Stocking
Soils
Accessibility
Available Markets

Forage

Amount
Kind
Seasonal Growth
Water Supply
Fences
Hazards

Recreation

Kinds
Local attraction
Population centers
Zoning
Competition
Water supply
Sewerage
Cost
Capital
Accessibility
Terrain

Water

Quality
Upstream use
Flow
Use
Potential

Wildlife

Tract size
Adjacent Land
Food
  Supply
  Variety
Habitat
Isolation
Shelter
Accessibility
Game laws
Law enforcement
Population centers

LANDOWNER CONSIDERATION

Desires
Personality
Ability
Land use
Net worth
Credit
Taxes
Insurance
Obligations
Land value
Assistance
Land Tenure

Land Use Plan

Land capability (soil, slope, etc.)
Management decision (mapped)
Protection
Key values (Timber, water, game, etc.)
Other uses
Coordination of uses

HABITAT NEEDS

Gray Squirrel. Hardwoods are a must for gray squirrels. They require partial hardwood stands of trees old enough (25 years) to produce mast and provide dens (40 years). The squirrels home range is 2—8 acres. Reproduction is 2½ times more successful in tree cavities than nests. Den entrance holes are usually 2½—3 inches in diameter and den cavities 14 inches in depth. They should be waterproof and 15 feet or more above ground level. A squirrel needs about 1½ lbs. of hard mast per week from September through March. Preferred foods are hickory nuts, beechnuts, white oak group and black (or red) oak group acorns, in that order. Supportive foods are berries, soft mast, buds, seeds, and fungi. Red maple is particularly important in early spring and mulberry in May and June.

Typical seasonable foods of gray squirrels are:

August-October	November-January	February-April	May-July
Hickory & Pecan	Hickory	Acorns ,	Buds &
Beech	Beech	(Blk Oak Grp.)*	Flowers
Blackgum	Walnut	Hickory	Berries
Acorns	Acorns	Beech	Mulberry
(White Oak Grp.)*	(White Oak Grp.)*	Buds & Flowers of	Fungi
Acorns	Acorns	Maple, Elm,	Blackberry
(Blk. Oak Grp.)	(Blk. Oak Grp.)	Oak, etc.	Yellow
Sugarmaple seeds	Blackgum	Fungi	Poplar
Pine seeds	Yellow Poplar	Red Maple seeds	
Walnut		Magnolia	
Fungi		Cucumber	
Dogwood			
Hawthorn			
Hornbeam			
Chinquapin			
Yellow Poplar			
Black cherry			

* The black (or red) oaks are characterized by bristles on the tips of leaf lobes and fruit matures at end of second season. White oak fruit matures at the end of the first growing season and leaf lobes are not bristle tipped.

Bobwhite Quail. Interspersed open forests, brush, grass, and cultivated fields are the best habitat for quail, but they survive in many forest types. Choice nesting cover is one-year-old grass. They also nest at the edges of forest clearings. Each nesting pair should have access to clearings 1/5-acre or larger. Eighty-five percent of the quail diet consists of seeds. Legume, grass, and weed seeds are most important foods (in that order). Normal range is 40 acres. Quail nest from April to September.

Important food species common to Piedmont and Coastal Plains forests, together with plant part utilized are:

Herbaceous Plants		Trees, Shrubs, and Vines	
Ragweed	Seed	Maple	Seed
Beggarticks	Seed	Hackberry	Seed
Partridge Pea	Seed	Flowering dogwood	Seed
Goatweed	Seed	Persimmon	Seed
Chufa, nut grass	Tubers	Bayberry	Seed
Tick trefoil (beggarweed)	Seed	Blackgum	Seed
Wild millet	Seed	Pines, longleaf, loblolly	
Lespedeza	Seed	(preferred)	Seed
Grasses	Seed	Cherry	Seed
Pokeweed	Berry	Oaks	Seed
Smartweed	Seed	Sumacs	Seed
Vetch	Seed	Blackberry	Berry
Panicum	Seed	Grapes	Berry
Milk Peas	Seed	Magnolia, bay	Seed
Butterfly peas	Seed	Sweetgum	Seed

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Beech	Beech	(Blk Oak Grp.)*	Flowers
Blackgum	Walnut	Hickory	Berries
Acorns	Acorns	Beech	Mulberry
(White Oak Grp.)*	(White Oak Grp.)*	Buds & Flowers of	Fungi
Acorns	Acorns	Maple, Elm,	Blackberry
(Blk. Oak Grp.)	(Blk. Oak Grp.)	Oak, etc.	Yellow
Sugarmaple seeds	Blackgum	Fungi	Poplar
Pine seeds	Yellow Poplar	Red Maple seeds	
Walnut		Magnolia	
Fungi		Cucumber	
Dogwood			
Hawthorn			
Hornbeam			
Chinquapin			
Yellow Poplar			
Black cherry			

* The black (or red) oaks are characterized by bristles on the tips of leaf lobes and fruit matures at end of second season. White oak fruit matures at the end of the first growing season and leaf lobes are not bristle tipped.

Bobwhite Quail. Interspersed open forests, brush, grass, and cultivated fields are the best habitat for quail, but they survive in many forest types. Choice nesting cover is one-year-old grass. They also nest at the edges of forest clearings. Each nesting pair should have access to clearings 1/5-acre or larger. Eighty-five percent of the quail diet consists of seeds. Legume, grass, and weed seeds are most important foods (in that order). Normal range is 40 acres. Quail nest from April to September.

Important food species common to Piedmont and Coastal Plains forests, together with plant part utilized are:

Herbaceous Plants		Trees, Shrubs, and Vines	
Ragweed	Seed	Maple	Seed
Beggarticks	Seed	Hackberry	Seed
Partridge Pea	Seed	Flowering dogwood	Seed
Goatweed	Seed	Persimmon	Seed
Chufa, nut grass	Tubers	Bayberry	Seed
Tick trefoil (beggarweed)	Seed	Blackgum	Seed
Wild millet	Seed	Pines, longleaf, loblolly	
Lespedeza	Seed	(preferred)	Seed
Grasses	Seed	Cherry	Seed
Pokeweed	Berry	Oaks	Seed
Smartweed	Seed	Sumacs	Seed
Vetch	Seed	Blackberry	Berry
Panicum	Seed	Grapes	Berry
Milk Peas	Seed	Magnolia, bay	Seed
Butterfly peas	Seed	Sweetgum	Seed

Wild Turkey. Good turkey habitat contains mature stands of mixed hardwoods, groups of conifers, relatively open understories, scattered clearings, well-distributed water, and reasonable freedom from disturbance. Home range is about one square mile. Turkey diet consists primarily of grass and weed seeds in the fall, mast and forage in winter and spring, and forage and insects in summer. Acorns, dogwood berries, clover and pine seed are the foremost foods. Soybeans, corn, chufas and pasture are the agricultural crops most frequently used. Openings are essential for brood range.

FOOD OF WILD TURKEY

Grass and Weed Seeds
- Paspalums (bull grasses)
- Panicums
- Native Legumes

Hard Mast
- Acorns
- Beechnuts
- Pecans

Forage
- Clovers
- Grasses
- Sedges

Soft Mast
- Dogwood
- Grapes
- Cherries

Other Tree Seeds
- Sweetgum
- Pine

Insects and Snails
- Grasshoppers
- Millipedes
- Insect Larvae

Berries
- Blackberries and Dewberries
- Huckleberries
- Strawberries

Grain
- Oats
- Corn

Ruffed Grouse. This game bird is found in the southern Appalachian Mountains and the Cumberland and Appalachian Plateaus, usually above 2,000 feet in elevation. It prospers in the early stages of forest succession but occurs in mature stands as well. Grouse use fruit, seed, catkins, buds and green parts of over 300 plants for food. Broods require insects from late May through July. Thickets, vine tangles and dense shrub growth are used for escape cover. Nesting cover is usually open understories near drumming logs and openings or old logging roads that serve as brood range. Home range is 40 to 50 acres.

Some favorite plant foods of grouse are:

Spring	Summer	Fall	Winter
Apple	Blackcherry	Crataegus	Birch
Serviceberry	Raspberry	Apple	Hophornbeam
Yellow Birch	Blackberry	Viburnum	Grape
Sumac	Dewberry	Beech	Apple
Strawberry	Strawberry	Huckleberry	Acorns
Hophornbeam	Mulberry	Sumac	Greenbriar
Various Catkins	Touch-Me-Not	Birch	Hazelnut
	Partridge berry	Dogwood	Sumac
	Crataegus	Grape	Laurel
		Acorns	Clover
			Teaberry
			Gold Seal
			Hepatica
			Christmas fern

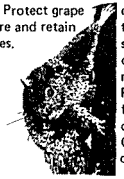
White Tailed Deer. Deer survive in most forest and non-forest conditions and types. The early stages of timber rotation and intermediate cuts produce abundant deer browse and fruits. During the fall and winter, deer prefer hard mast (acorns, pecans, beechnuts) and evergreen forage. Rapid-growing green browse and herbage are principal spring and summer foods. Deer require about 6 to 8 lbs of green weight food daily for each 100 lbs. weight. Their home range seldom exceeds 300 acres where food, cover and water are interspersed. Prescribed burning and fertilization attract deer because of improved nutrition and palatability of food plants.

Important deer browse species by physiographic province, in order of preference are:

Mountains	Piedmont	Coastal Plain
Greenbriar	Japanese Honeysuckle	Black Titi
Azalea	Greenbriar	Tall Gallberry
Blueberry	Yellow Poplar	Greenbriar
Chestnut	Azalea	Honeysuckle
Dogwood	Viburnums	Blackberry
Blackgum	Sourwood	Yellow Jessamine
Oak	Blackgum	Myrtle Holly
Sourwood	Dogwood	Wild Rose
Mtn. Laurel	Soft Maple	Deer's Tongue
Huckleberry	Blueberry	Mushrooms
Strawberry Bush	Cherry	Sumac
Buffalo Nut	Persimmon	Prickly Pear
Japanese Honeysuckle	Blackberry	Yaupon
Blackberry	Strawberry-Bush	Sassafras
Sumac		Viburnums
Hydrangea		Strawberry-Bush
Aralia		
Grape		
Rhododendron		

Timber Prescription Guides for Wildlife Habitat Management By Stages of Stand Development

GRAY SQUIRREL

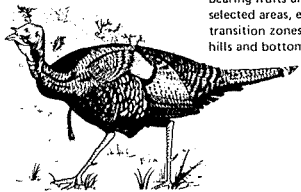
Seedling or Open	Sapling	Pole	Young Sawtimber	Mature Sawtimber
Exclude fire and grazing. Without desirable hardwood sprout or seedling reproduction, opportunities for habitat improvement are slim. If present when regenerating, retain two den trees per 5 acres that have a 25-year life expectancy or more.	Thin to release a variety of oaks, hickory, walnut, beech and pecan trees. Protect grape vines, exclude fire and retain vigorous den trees. 	Thin early and heavy to release mast trees and to promote vigorous growth of future sawtimber trees and understory fruit-bearing shrubs and trees. Retain existing or potential den trees such as maple, beech, and black cherry. Promote vigorous growth of future sawtimber and fruiting of understory shrubs and trees. Oak, beech and hickory should comprise about 1/2 of stand.	Cut to favor a good mixture of large mast producers and den trees. Retain existing den trees and thin. Protect grape vines. Thin heavily dense mid-stories.	Make salvage and sanitation cuts and retain a variety of healthy mast producing and den trees. Prior to regeneration, make heavy cuts to encourage oak reproduction. Regenerate hardwoods with clearcuts or large group selection to get rapid early growth. Inventory to assure that oak reproduction is present prior to regeneration harvest cutting.

BOB WHITE QUAIL

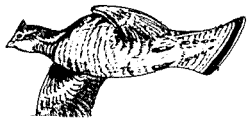
Seedling or Open	Sapling	Pole	Young Sawtimber	Mature Sawtimber
This stage of pine stands can be most productive for quail since regeneration areas are excellent habitat for 1 - 4 years. Double chop during Oct. - March to lengthen period of site preparation for quail. Plow out or leave one-year roughs one acre in size for nesting. Plant pines at wide spacing (300-500 per acre). Protect old home sites, spring heads and branch bottoms. If warranted, plant legumes in long, narrow (about 20 ft. wide) food strips through the woods (see local game biologists for species).	Prescribe burn older sapling pine stands to encourage herbaceous growth. Thin to hasten stand development and open forest floor. Maintain small openings with disc or fire. Protect old house sites, branch stringers, and food patches.	Thin early and heavy in pine stands. Prescribe burn in 3-yr. intervals to promote grasses, weed seeds. Exclude fire from the best seed and berry producing understory areas.	Develop park - like pine sawtimber stands by thinning and burning. Exclude fire from edges, plum thickets and fringes of branch bottoms. Prescribe burn portions of stands on 2 - 3 year schedule. Plow out one-year roughs for nesting and special food areas. Use natural openings and firebreaks for supplemental food patches of 1 to 2 acres per 160 acres. Plant legumes such as lespedeza bicolor, partridge pea and common lespedeza. Strips should be long and narrow and lead away from bays and springs.	Maintain park - like stands. At regeneration, protect seed and fruit bearing trees and shrubs along fringe or edge. Log and do cultural activities in winter or late fall. Under such conditions pine stands can be managed for decades on good sites if trees are given room to grow and if selected insect and disease tree removals are made. Prescribe burn on 2 to 3 year interval.

WILD TURKEY

(Not completely manageable on small tracts, but purposeful stand management can help support turkeys and attract them to specific areas.)

Seedling or Open	Sapling	Pole	Young Sawtimber	Mature Sawtimber
This stage provides nesting and brood range. Plant pines at 10' x 10' or 10' x 12' spacing to aid rapid stand development and lengthen the grass and forb production period. Avoid site disturbances Mar. through June to protect nesting and brood areas. Manage for sawtimber rotation in both pine and hardwood stands. One-fourth of each square mile should be managed to produce mast bearing species if possible.	In hardwoods thin to favor oaks, beech and other turkey mast. In older sapling pine, burn Dec. – Feb. to encourage grass and forb production. (Turkeys seldom use stands of this stage.) 	Thin to release mast producers in hardwoods and pine hardwood stands. Retain 20 to 50% of the stand in oak and beech. In pine, prescribe burn portions of the stand at 3 to 5 year intervals in Dec. through Feb. Protect shrubs bearing fruits and soft mast in selected areas, especially in transition zones between pine hills and bottoms when burning.	Cut to improve and maintain a variety of mast bearing trees and fruit bearing shrubs. Break up large areas of dense understory. Use fire or logging to keep pine stands open. Confine harvesting season to July - Feb. and remove all products in same operation to reduce disturbance.	Apply 80 to 100 year rotation. Maintain pine in medium to fully stocked stands to prevent a heavy midstory. Burn pine stands in Dec. - Feb. on a 3 to 5 year cycle. Consider surrounding stands in selective regeneration areas to maintain diversity. At harvest and before regeneration, plan to remove all commercial and noncommercial stems to assure development of intolerant mast bearing seedlings and sprouts. Harvest July - Feb. in one operation or as quickly as possible in stand sizes up to 100 acres in size. Distribute cuts to minimize disturbance and other impacts and retain sawtimber stands needed for turkey habitat.

RUFFED GROUSE

Seedling or Open	Sapling	Pole	Young Sawtimber	Mature Sawtimber
Prepare sites for conifers and maintain openings by prescribed fire or discing possibly in early spring. Protect and maintain old house places, thickets of thornapple and grape, old apple trees, and patches of clover, which are aids to hunting. Plant or encourage conifer patches (1 to 5 acres in size) in extensive hardwood areas.	Develop a wide variety of species when making precommercial thinnings. Break up extensive stands of conifers with pockets of hardwood. 	Cut to maintain a variety of tree species and encourage understory shrub growth. Thin early and frequently.	Maintain rapid growth of overstory and a vigorous shrub understory through thinnings. Reduce midstory stems. Maintain variety of species mixture in overstory and understory.	Maintain vigorous shrub understories while favoring rapid growth in the overstory through thinnings. Regenerate in well-distributed stands (1 to 40 acres in size). Space and schedule cuts to make at least one available during each cutting period.

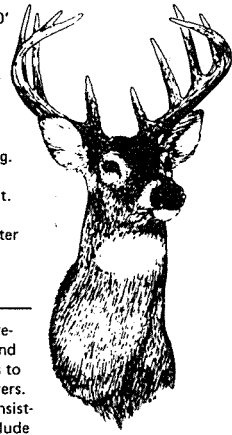
WHITE TAILED DEER

Seedling or Open

Plant pine seedlings at 10' x 10' or greater spacing (436 or less per acre). Prepare sites in early spring. Favor burning over mechanical means to retain root crowns of browse plants. Protect hardwood regeneration from grazing and over-browsing. Avoid long continuous windrows that deter deer movement. Retain old house sites, water areas, thickets and unique winter cover areas (primarily in oak-hickory stands.)

Sapling

In older sapling pine stands, prescribe burn to produce forbs and browse. Thin hardwood stands to favor oaks and other fruit bearers. Favor a variety of high and consistent fruit and nut yielders. Exclude fire and grazing from hardwood stands.



Young Sawtimber

Selectively cut hardwood stands, cut to maintain a variety of mast trees; where it is scarce, protect winter cover and browse such as honeysuckle, laurel, etc. Prescribe burn pine stands every 3 - 5 years. Intermediate cuts help produce sprouts and other browse. Maintain openings by burning or mowing.

Pole

In thinnings, favor oaks and other mast trees. Stimulate early diameter growth. Retain a wide variety of fruit and mast trees in the understory. In hardwood stands favor black oaks 2 to 1 over white oaks, and exclude fire.

Mature Sawtimber

Maintain hardwood stands at full or near-full stocking until regeneration; then cut stand heavy enough to encourage oak reproduction. Protect evergreen browse, cover and water areas in harvest cuts. Defer regeneration of mature hardwood mast stands where scarce (less than 20% of area within a 300-acre range). Cut pine stands frequently to maintain understory browse variety and break up dense midstories. When regenerating select and retain key areas such as hardwood component stringers, evergreen browse patches, water holes, old orchards, etc.

COORDINATION OF BURNING

PURPOSE	TIME OF BURN	SIZE OF BURN	TYPE OF FIRE	FREQUENCY	REMARKS
REDUCE FUELS	Winter	Large enough to break fuel continuity	Heavy rough – *backfire.* Moderate-to-light roughs – *Strip-Head*	2 to 4 years	For plantation maintenance burns, annual head fires may be used after reducing heavy roughs by an initial backfire.
IMPROVE WILDLIFE HABITAT					General – Protect transitional or fringe areas.
Deer	Winter preferred	200 + acres*	Winter – *backfire*	3 to 5 years	In south central Alabama, late fawning rules out summer burns.
Turkey	Winter preferred–avoid March thru July; Summer burns – August only	200 + acres*	Winter – *backfire* Summer – *strip-head*	3 to 5 years	
Quail	Winter only	Checkerboard or strip if over 160 acres	*Backfire* or *strip-head*	2 years	Leave thickets, stream bottoms.
Dove	Winter	Not critical		Not critical	Leave thickets, stream bottoms.
Waterfowl	Winter	Not critical		Not critical	Not recommended in hardwood sites – marshy areas only (exposes seeds and roots).
CONTROL DISEASE	Brownspot – winter	Dependent on infected area – include a buffer strip	*backfire* or *strip-head* (strip-head with higher humidities and light fuels is usually best)	2 to 3 years	Avoid leaving unburned pockets of infected seedlings within or immediately adjacent to burn if possible.
ENHANCE APPEARANCE	Winter	Varies with each individual situation – generally small	*Backfire*	1 to 5 years	Requires precise prescriptions to protect vegetative type changes. Recognize effect on annual and biennial flowering plants. Provide pleasing visual lines. Time and method of burning may be critical to public acceptance.

PURPOSE	TIME OF BURN	SIZE OF BURN	TYPE OF FIRE	FREQUENCY	REMARKS
PREPARE SITES FOR SEEDING AND PLANTING	*Planting* – Growing season for hardwood control, fall and winter for planting. *Direct Seeding* – Fall and Winter for spring sowing. In some areas previous winter for fall sowing of longleaf. *Natural Seeding* – Summer and early fall prior to natural seed fall.	Large enough to prevent concentrations of birds & rodents (usually 10 acres or more).	Planting or Direct Seeding – *ring fire* in slash areas; *flank*, or *striphead fire* Natural Seeding – summer – *strip-head* winter – *backfire*		Recognize impact on water and wildlife resources since these are generally hot fires.
MANAGE UNDERSTORY VEGETATION	Heavy roughs – winter. Moderate roughs – winter, spring, or summer.	Not critical	Winter – *backfire* Spring and Summer Summer – *back* or *strip-head*	Varies with management objectives	Summer burns generally result in higher mortality and affect larger stems. Exclude fire from desirable hardwoods in hardwood and pine hardwood types.
IMPROVE FORAGE	Winter for most situations. Split burn if possible (example – Dec. and Feb.).	Dependent on size of ownership	Not critical but relate to other resources	3 to 4 years	Split burning provides higher nutritional values over a longer period. Individual grass and forb species respond differently to fire. Knowledge of species present and reaction to fire important.
IMPROVE ACCESSIBILITY	Will vary with species, understory, and desired use.	Varies with individual situation	The more rough – the less intense burning technique should be used.		Objectives for burn will influence size, time frequency of burn. Coordinate with other resource objectives.

**Size of ownership, adjacent land use, etc., may affect size of burn; i.e., on a 200-acre tract, burns of 40 to 60 acres per year provide variety of conditions.*

***For smoke management purposes, use a backing fire whenever possible, as this technique produces less particulate matter.*

Firewood Weight/Volume Relationship
(Calculating Net Heat Value for Firewood)*

Heat Value of Dry Wood

The heat value of wood per unit of weight is about the same for all species: 8,600 Btu per pound, ovendry weight. Exceptions to this rule are very resinous species, which have slightly higher values. The heat value of hardwood bark is slightly lower than that of wood, while the energy content of pine bark is slightly higher.

The heat value of wood per unit of volume, at a given moisture content (MC), depends upon its specific gravity, or relative density. The higher the specific gravity (SG) of a wood, the denser the wood per unit of volume, and the higher its heat value.

The table on page 117 groups common tree species by relative density classes. Each class represents a different range of specific gravities of wood, and each class has been assigned an average specific gravity factor. This factor is used to calculate the approximate amount of heat energy available in a given volume of dry wood.

Calculation of Gross Heat Value (GHV)

To calculate the GHV of a cord of dry wood, two assumptions are first made:

--a cord (CD) of dry wood contains 80 ft^3 of solid wood;

--each pound of ovendry wood, regardless of species, can produce 8,600 Btu of heat energy.

*Prepared by A. B. Curtis, USDA Forest Service, Southeastern Area.

Relative density classes, based on specific gravity, for common tree species, with average specific gravity factors. 1/

	Low-Density Woods	Medium-Density Woods	High-Density Woods
SG Range:	less than 0.50	0.50-0.59	greater than 0.59
Avg. SG Factor:	0.45	0.55	0.65
Species, common names:	Aspen	Ashe, green	Ashe, white
	Baldcypress	Birch, paper	Beech
	Basswood	Cherry, black	Birches:
	Butternut	Elms:	Sweet
	Cedar	American	Yellow
	Cottonwood	Slippery	Dogwood
	Fir	Hackberry	Elm, rock
	Hemlock	Holly, American	Hickory
	Maple, silver	Magnolia	Honeylocust
	Pines:	Maple, red	Hophornbeam
	Eastern white	Pines:	Hornbeam
	Jack	Loblolly	Locust, black
	Red	Longleaf	Maple, sugar
	Sand	Pitch	Oak
	Spruce	Pond	Osage-orange
	Virginia	Shortleaf	Pecan
	Sassafras	Slash	Persimmon
	Sycamore	Sweetgum	
	Willow, black	Tamarack	
	Yellow-poplar	Tupelo	
		Walnut, black	

1/ Specific gravity is based on ovendry weight and volume at 12% moisture content. The average specific gravity factors shown here were arbitrarily chosen to represent all species within a certain density class.

The formula for calculating gross heat value is:

$$GHV = SG\ factor \times [62.3\ lb./ft.^3\ (wt.\ of\ water) \times 80\ ft.^3/CD. \times 8600\ Btu/ovendry\ lb.]$$ 2/

2/ $[62.3\ lb/ft.^3 \times 80\ ft.^3/CD. \times 8600\ Btu/O.D.\ lb.]$

= 42,862,400 Btu/per cord.

This formula is used to derive approximate GHV's [1/] for each of the three density classes:

Low-density woods

GHV = 0.45 x 42,862,400 Btu per cord.

= 19.3 million Btu per cord (MMBtu/CD.)

Medium-density woods

GHV = 0.55 x 42,862,400 Btu per cord.

= 23.6 MMBtu/CD.

High-density woods

GHV = 0.65 x 42,862,400 Btu per cord.

= 27.9 MMBtu/CD.

Use the following table to provide a more precise GHV, if a species' average specific gravity is known.

Gross heat value of ovendry wood by specific gravity

Relative Density or Specific Gravity	Gross Heat Value Per Cord (MMBtu)
.30	12.8
.35	15.0
.40	17.1
.45	19.3
.50	21.4
.55	23.6
.60	25.7
.65	27.9
.70	30.0
.75	32.1
.80	34.3
.85	36.4
.90	38.6

1/ These GHV's are only approximations of Btu's available from a cord of dry wood of a species group. If a more precise heat value is needed for a particular species, the average SG of that species must be used in place of the density class SG factor. SG values for most woods can be found in The Wood Handbook (USDA FS, For. Prod. Lab., Ag. Hdbk No. 72).

For example, if we knew the average SG of balsam fir were 0.36, we could use the preceding table to determine a more exact GHV for a dry cord of balsam fir: 15.4 million Btu. This figure is certainly a better approximation than the 19.3 million Btu derived through the use of the first and the generalized GHV formulas for broad density classes.

Note that the GHV's calculated by the density class method are only approximations; they are meant to provide relative values for large groups of woods. More realistic GHV's can be derived, however, by using the same general formula and by substituting a more precise SG value for the standard SG value shown in the first table.

Also note, at this point, that gross heat values represent the maximum Btu values for ovendry wood. To find the actual, or net, heat value of a cord of green or partly dried wood, other factors must be considered, such as the amount of water in the wood and the combustion efficiency of the device in which that wood is to be burned.

Heat Value of Green Wood

All wood except that artificially dried in the laboratory contains some amount of water, commonly expressed as moisture content (MC). Though there are two accepted methods of calculating MC, most wood technologists calculate MC on the basis of ovendry weight (ODWT), as follows:

$$MC\% = \frac{\text{Green Weight} - \text{ODWT}}{\text{ODWT.}} \times 100 \quad \text{[Equation 1]}$$

In the above equation, the green weight (GWT) and ODWT of a given volume of wood must be known. If the MC and ODWT of a cord

of wood are known, GWT can be calculated as follows:

$$GWT = ODWT. \left(1 + \frac{MC\%}{100}\right) \quad \text{[Equation 2]}$$

Using the same relationships, and knowing both GWT. and MC, ODWT. can be found this way:

$$ODWT. = \frac{GWT.}{1 + \frac{MC\%}{100}} \quad \text{[Equation 3]}$$

If MC, ODWT, and GWT of a cord of wood are not known, but the SG of that wood is, we can calculate ODWT another way:

$$ODWT/CD = SG \times 62.3 \text{ lb./ft}^3 \times 80 \text{ ft}^3/CD. \quad \text{[Equation 4]}$$

All of these equations are helpful in calculating the low heat value (LHV) of wood. This value is defined as the amount of heat energy available in a given volume of wood after accounting for the energy needed to evaporate the water in the wood, but before accounting for the combustion efficiency of the device in which the wood is burned. After determining LHV, combustion efficiency can be factored in to arrive at the bottom line, net heat value (NHV).

Calculation of Low Heat Value (LHV)

To estimate LHV it is necessary to know the weight of water contained in a given volume of wood. That water must be evaporated before wood can burn. This water evaporation requires about 1,210 Btu per pound of water, and the total energy needed to evaporate all the water in the wood must be deducted from GHV to arrive at LHV.

Take as an example a cord of "green" red maple. Assume approximate heat values are all that is required. The tables on pages 117-118 suggest the GHV for red maple to be 23.6 million Btu per cord. To simplify the process, assume green woods have an average MC of 75%, ODWT basis. [The reported average MC for red maple is 70%]. At 75% MC, how many pounds of water are in a cord of red maple? This value would be the difference in weight between a green cord and an ovendry cord.

Recall that Equation 4 can be used to calculate ODWT/CD, if we know the SG. Because an approximation of LHV is all that is required for this example, use .55 as average SG (See table, page 117).

ODWT/CD = 0.55 x 62.3 x 80 = 2,741 pounds.

With values for MC and ODWT, Equation 2 can be used to calculate GWT:

$$GWT/CD = 2,741 \left(1 + \frac{75\%}{100}\right)$$

$$= 2,741 \ (1.75)$$

$$= 4,797 \text{ pounds}$$

Weight of water in the cord would be:

Wt. of water/CD = GWT/CD - ODWT/CD

= 4,797 lb. - 2,741 pounds

= 2,056 pounds

The amount of energy needed to evaporate this weight of water is 2.5 a million Btu per cord, i.e.,

1,210 Btu/lb. of water x 2,056 lb. of water/CD

Now deduct this value from GHV to arrive at LHV:

LHV = 23.6 MMBtu/CD.-2.5 MMBtu/CD. = 21.1 MMBtu/CD

Calculation of Net Heat Value (NHV)

Calculation of net heat value requires reducing LHV to account for energy losses which occur during the combustion process. These Btu losses may be due to excessive air entering the combustion chamber, excessively high temperatures of flue gases, or simple radiation losses. Btu losses are generally related to stove or furnace efficiency.

of wood are known, GWT can be calculated as follows:

$$GWT = ODWT. \left(1 + \frac{MC\%}{100}\right) \quad \text{[Equation 2]}$$

Using the same relationships, and knowing both GWT. and MC, ODWT. can be found this way:

$$ODWT. = \frac{GWT.}{1 + \frac{MC\%}{100}} \quad \text{[Equation 3]}$$

If MC, ODWT, and GWT of a cord of wood are not known, but the SG of that wood is, we can calculate ODWT another way:

$$ODWT/CD = SG \times 62.3 \text{ lb./ft}^3 \times 80 \text{ ft}^3/CD. \quad \text{[Equation 4]}$$

All of these equations are helpful in calculating the low heat value (LHV) of wood. This value is defined as the amount of heat energy available in a given volume of wood after accounting for the energy needed to evaporate the water in the wood, but before accounting for the combustion efficiency of the device in which the wood is burned. After determining LHV, combustion efficiency can be factored in to arrive at the bottom line, net heat value (NHV).

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To estimate LHV it is necessary to know the weight of water contained in a given volume of wood. That water must be evaporated before wood can burn. This water evaporation requires about 1,210 Btu per pound of water, and the total energy needed to evaporate all the water in the wood must be deducted from GHV to arrive at LHV.

Take as an example a cord of "green" red maple. Assume approximate heat values are all that is required. The tables on pages 117-118 suggest the GHV for red maple to be 23.6 million Btu per cord. To simplify the process, assume green woods have an average MC of 75%, ODWT basis. [The reported average MC for red maple is 70%]. At 75% MC, how many pounds of water are in a cord of red maple? This value would be the difference in weight between a green cord and an ovendry cord.

Efficiencies of stoves, fireplaces, and other heating devices are affected by the design, quality of installation, location, indoor and outdoor temperatures, and use patterns. Fireplaces range in efficiency from -10 to 15%, box stoves 20-40%, and airtight stoves 25-70%.

To calculate NHV it is necessary to know which type of heating device will be used to burn the wood, and then to apply a combustion efficiency factor to the LHV.

Assume an airtight stove is to be used to burn a cord of red maple, and that it's a new, carefully installed and properly located stove. Its combustion efficiency factor will be at least 60%.

Net Heat Value (NHV) = 0.60 x 21.1 million Btu per cord.

= 12.7 million Btu per cord.

For this example, under the assumptions made, a green cord of red maple burned in a 60% efficient airtight stove would produce approximately 12.7 million Btu's net heat energy.

If the average reported SG for red maple (0.54) and that species' average reported green MC (70%) had been used in the calculation of NHV (in an effort to derive a more precise value), the NHV would have been 12.5 million Btu per cord, only 0.2 million Btu off the approximation [1.6% error].

The process of calculating NHV can be summarized this way:

1. GHV (MMBtu/CD) = SG x 42.862 MMBtu/CD.
2. LHV (MMBtu/CD) = GHV - [1,210 Btu/lb. x lb. water/CD]
3. NHV (MMBtu/CD) = Combustion Efficiency Factor x LHV

When assessing the energy content of a cord of firewood, the most important parameter is the ovendry density for that species because a pound of dry wood of any species has about the same energy content. If all species were sold at the same price, the best buy would, of course, be the denser wood, assuming equal moisture contents. When buying wood by the pound, the most important parameter is moisture content, and the driest wood would be the best buy.